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Report of the Commission of Inquiry on Aluminum Wiring

Part 3

J. Tuzo Wilson, *Commissioner*



ONTARIO

March
1979



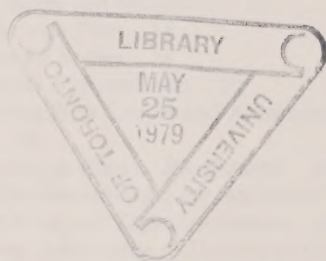
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3.1 Exhibits Entered at Hearings of the Commission of Inquiry on Aluminum Wiring

<i>Exhibit No.</i>	<i>Description</i>	<i>Exhibit No.</i>	<i>Description</i>
1-A	A receptacle of the push-in type (p. 70*).	11	Three photographs of receptacles and aluminum-wire connectors under test at Aluminum Company of Canada, Ltd., Research Centre, Kingston, Ontario (p. 156).
1-B	A length of aluminum electric wire (p. 70).	12	A receptacle, marked "A.E.C.", installed in 1948 in a house in Arvida, Quebec, and removed in 1976 in satisfactory condition (p. 163).
2	A receptacle of the binding-head screw type, manufactured by Canadian General Electric Company Limited (p. 71).	13	A switch, installed in 1948 in a house in Arvida, Quebec, and removed in 1976 in satisfactory condition (p. 163).
3	A junction box, manufactured by Crouse-Hinds Canada Limited (p. 72).	14	A chart entitled <i>Electric Power Distribution System</i> (p. 200).
4	A length of insulated aluminum wire with a tin-plated lug at one end (p. 73).	15	A colour photomicrograph, of 200x magnification, that shows a cross section of an interface of aluminum and brass between which intermetallic compounds had formed (p. 241).
5	A length of aluminum branch-circuit conductor, marked "NUAL NMD-7," manufactured by Alcan Canada Products Limited (p. 140).	16	A letter, dated October 10, 1974, from Dr. R.S. Timsit, Alcan International Limited [Aluminum Company of Canada, Ltd.], Research Centre, Kingston, Ontario, to Dr. U. Franklin (p. 248).
6	A junction box, manufactured by Leeds & Northrup, Canada, Ltd.; a receptacle of the copper/aluminum revised (CO/ALR) type, manufactured by Smith & Stone Limited; a cover plate, manufactured by Leviton Manufacturing of Canada Ltd. (p. 141).	17	A memorandum, dated February 20, 1976, from Mr. R.L. Hicks, W.P. Dobson Research Laboratory, Ontario Hydro, Toronto, Ontario, to Canadian Standards Association Working Group on Branch Circuit Wiring (p. 267).
7	A junction box fitted with an overhead lighting fixture, manufactured by Columbia Electric Ltd. (p. 143).	18	A transparency that shows the technical conclusions presented by Dr. U. Franklin (p. 299).
8	A receptacle of the CO/ALR type, manufactured by Smith & Stone Limited (p. 145).	19	A transparency that shows equations dealing with diffusion (p. 299).
9	A receptacle of the pre-CO/ALR type, manufactured by Leviton Manufacturing of Canada Ltd., which showed evidence of failure after six years' service (p. 148).	20	A binder containing various documents compiled by Canadian Standards Association (p. 324).
10	A receptacle of the pre-CO/ALR type, manufactured by Leviton Manufacturing of Canada Ltd., which did not show evidence of failure after six years' service (p. 149).		

*The page number of the transcript of the Commission's proceedings, where reference is made to the particular exhibit.

<i>Exhibit No.</i>	<i>Description</i>	<i>Exhibit No.</i>	<i>Description</i>
20-A	A book entitled <i>List of Certified Electrical Equipment, 1977, Canadian Standards Association</i> (p. 337).	30	A booklet, marked "Specification C 22.2 No. 42-1959" and entitled <i>Construction and Test of Receptacles, Plugs and Similar Wiring Devices (Third Edition), CSA Standard, June, 1959</i> (p. 563).
21	A document entitled <i>Canadian Electrical Code, Part 1, Section 12, Wiring Methods — Low Voltage</i> (p. 382).	31	A booklet, dated October 26, 1976, marked "Manitoba Hydro, Manitoba Regulation 248/76" and entitled <i>Standards of Wiring and Other Electrical Facilities</i> (p. 634).
22-A	Three loose-leaf binders containing to various documents compiled by Mr.	32	A receptacle of the push-in type, manufactured by Smith & Stone Limited (p. 744).
22-C	D.M. Dymond, Director, Standards Division, Canadian Standards Association (p. 385).	33	A working paper, dated May 18, 1976, of the Working Group on Branch Circuit Wiring, Canadian Standards Association (p. 831).
23	A crimping tool of the AMP 68198-1 type, manufactured by AMP Incorporated (p. 456).	34	A document, dated August 1977, entitled <i>Public Electrical Safety in Ontario</i> (p. 892).
23-A	A box of connectors of the AMP type, manufactured by AMP Incorporated (p. 457).	35	A biographical note on Mr. J.A. Dicker, Manager, Electrical Inspection Department, Ontario Hydro, Toronto, Ontario (p. 895).
24-A	Five crimping tools of different types, and a photograph of the tools, one each of three types manufactured by Stanley Works of Canada Limited, Vaco Products Company, and Oxwall Tool Co.; and one each of two types labelled "Super Quality Tools" (p. 461).	36	A handbook entitled <i>Electrical Safety Code, Ontario Hydro, 17th Edition, 1972</i> (p. 897).
25	Three packages of connectors labelled, respectively, "spade terminals," "butt connectors," and "closed-end connectors." All bear the name "Motormaster," and are distributed by Canadian Tire Corporation, Limited (p. 462).	37	A handbook entitled <i>Canadian Electrical Code, Part 1, Twelfth Edition, CSA Standard C22.1 — 1975</i> (p. 897).
26	A photograph of three receptacles that show evidence of overheated connections (p. 464).	37-A	A booklet entitled <i>Supplement Electrical Safety Code, Ontario Hydro, 18th Edition, 1977</i> (p. 898).
27	A photograph of a connection of the crimp type, that shows shrinkage of the insulating sleeve and evidence of heating (p. 464).	38	A booklet entitled <i>Ontario, The Power Corporation Act, R.S.O. 1970, Chapter 354, March, 1974</i> (p. 899).
28	A Canadian Standards Association Special Bulletin, dated June 9 and 10, 1975, entitled <i>Aluminum Wire No Threat</i> (p. 492).	39	A copy of <i>The Ontario Gazette</i> , vol. 106-15, dated April 14, 1973, referring to Regulation 168 for 1973 (p. 900).
29	A Canadian Standards Association Special Bulletin, dated June 23, 1976, entitled <i>Standards to Be Changed</i> (p. 492).	40	A printed sheet entitled <i>Ontario Hydro, Application for Electrical Inspection</i> (p. 903).
		41	A booklet entitled <i>Ontario Hydro, 1976 Inspection Fees</i> (p. 903).

<i>Exhibit No.</i>	<i>Description</i>	<i>Exhibit No.</i>	<i>Description</i>
42	A set of standard forms to be used during inspection of installations by Ontario Hydro (p. 906).	52	Reports by the City of Mississauga Fire Department and the Ontario Fire Marshal referring to a fire on September 30, 1975 at the residence of Mr. and Mrs. T. Wilkinson, 2537 Mindemoya Road, Mississauga, Ontario (p. 1492).
43	A standard form entitled <i>Ontario Hydro, Notice of Deficiency</i> (p. 907).	53	A receptacle of the combination type, that shows evidence of failure, from the residence of Mr. G. Hancock, 1485 Gullenden Drive, Townhouse No. 22, Mississauga, Ontario (p. 1520).
44-A	A bound document entitled <i>Residential Wiring Research Program, Detailed Results</i> by Mr. R.L. Hicks (p. 930).	54	Three bundles of coloured conductors with taped splices, from the residence of Mr. P.T. Boychuck, 17 Davenport Crescent, Mississauga, Ontario. <i>See also</i> Exhibit 81 (p. 1585).
45	A biographical note on Mr. R.L. Hicks, P.Eng., Utilization Engineer, W.P. Dobson Research Laboratory (Electrical Research Department), Ontario Hydro, Toronto, Ontario (p. 930).	55	A photograph that shows a receptacle in a kitchen cupboard in the residence of Mr. L. Halbach, 24 Seaborn Road, Brampton, Ontario. <i>See also</i> Exhibits 56-7, 59 (p. 1595).
46	A receptacle with five short lengths of aluminum wires attached to its binding-head screws (p. 988).	56	A photograph that shows wiring, of the heavy-gauge type, passing through joists and partially wrapped around hot-air ducts in the basement of the residence of Mr. L. Halbach. <i>See also</i> Exhibits 55, 57, 59 (p. 1601).
47	A booklet entitled <i>Vacation Homes, Electrical Inspection Guide, Ontario Hydro</i> (p. 1130).	57	A photograph that shows wiring, of the light-gauge type, passing through joists and partially wrapped around hot-air ducts in the basement of the residence of Mr. L. Halbach. <i>See also</i> Exhibits 55-6, 59 (p. 1602).
48	A letter, dated May 13, 1976, from Mr. R.L. Hicks to Mr. D.M. Manson, concerning a Working Group on Branch Circuit Wiring (p. 1226).	58	A newspaper clipping, dated October 20, 1976, entitled "Madoc Resident Afraid of Wire" (p. 1719).
49	An Ontario Hydro Inspector's Report and a City of Brampton Fire Department Occurrence Report referring to a fire on December 27, 1976 at the residence of Mr. and Mrs. W. Upcott, 21 Charters Road, Brampton, Ontario (p. 1472).	59	Three receptacles of the Cu-Al type, manufactured by Smith & Stone Limited, that shows no visible evidence of failure, from the residence of Mr. L. Halbach, 24 Seaborn Road, Brampton, Ontario. <i>See also</i> Exhibits 55-7 (p. 1619).
50	Reports by the City of Brampton Fire Department and the Canadian Standards Association, referring to a fire on June 10, 1977 at the residence of Mr. J.E. Cowley, 15 Davenport Crescent, Brampton, Ontario (p. 1472).	60	A receptacle, manufactured by Eagle Electric of Canada Ltd., that shows evidence of failure, from the residence of Mr. R. McBrien, 966 Forestwood Drive, Mississauga, Ontario (p. 1622).
51	Reports by the City of Mississauga Fire Department and the Ontario Fire Marshal referring to a fire on January 14, 1977 at the residence of Mr. W.J. Bates, 2676 Canberra Road, Mississauga, Ontario (p. 1490).		

<i>Exhibit No.</i>	<i>Description</i>	<i>Exhibit No.</i>	<i>Description</i>
61-A	Two receptacles, manufactured by Eagle and Electric of Canada Ltd., from the	66-D	A letter, dated February 28, 1977, to the Aluminum Wiring Assoc. [Aluminum Wiring Home Owners Association], at the address given as P.O. 424, Brampton, Ontario, from Mr. G. McIlwain, 363 Simcoe Street North, Suite 103, Oshawa, Ontario (p. 1788).
61-B	residence of Mr. G. Lavoy, 10 Bingham Road, Brampton, Ontario. <i>See also</i> Exhibit 61-C (p. 1622).	66-E	A letter, dated September 22, 1977, to the A.W.H.O. [Aluminum Wiring Home Owners Association], Box 424, Brampton, Ontario, from Mr. J.L. Osborne, Sarcee Meadows Housing Co-operative Ltd., Box 50, 4020 — 37th Street S.W., Calgary, Alberta (p. 1791).
61-C	A photograph that shows the installation of a receptacle in the residence of Mr. G. Lavoy. <i>See also</i> Exhibits 61-A, 61-B (p. 1626).	67-A	A document, entitled <i>Technical Bulletin, No. 75-3, November 17, 1975</i> , with reference to "Aluminum Wiring," by C.E. Scott, and issued by Insurers' Advisory Organization of Canada, Limited (p. 1798).
62	A receptacle of the push-in type, marked "Cu-Al", from the residence of Mr. D. Griffith, 8 Bingham Road, Brampton, Ontario (p. 1623).	67-B	A document, dated September 1976, entitled <i>Improving the Safety of Mobile Homes</i> , a study prepared by E. Marotta and issued by Insurers' Advisory Organization (p. 1798).
63	A receptacle, manufactured by Canadian General Electric Company Limited, from the residence of Mr. J. Shields, 78 Heggie Drive, Brampton, Ontario (p. 1623).	68	A letter, dated August 1, 1977, to Mr. L.S. Nielsen, Director, Codes Bureau, Division of Housing and Community Renewal, 2 World Trade Center, New York, New York, U.S.A., from Mr. A.J. Reed, General Manager, Bureau of Electricity, The New York Board of Fire Underwriters, 85 John Street, New York, New York, U.S.A. (p. 1833).
64	A receptacle of the push-in type, marked "Cu-Al", manufactured by Smith & Stone Limited, from the residence of Mr. Brenner, 6 Bingham Road, Brampton, Ontario (p. 1624).	69	A letter, dated September 18, 1976, from Mr. G. Heighington, 24 Glencastle Square, Bramalea, Ontario, to Mr. J.O. Reeve, Canadian Standards Association, Rexdale, Ontario; and the reply, dated October 8, 1976 (p. 1834).
65	A photograph that shows a receptacle and connected wires from the residence of Mrs. V. Talbot, 22 Grassington Court, Brampton, Ontario (p. 1738).	70	A receptacle of the push-in type, manufactured by Smith & Stone Limited, from 2 Hazelglen Court, Bramalea, Ontario (p. 1843).
66-A	A letter, dated April 30, 1977, to the Aluminum Wiring [Home Owners] Association, at the address given as P.O. Box 424, Brampton, Ontario, from Mrs. G. Haughton, Box 408, Beeton, Ontario (p. 1784).	71	A receptacle of the steel-screw type, marked "CSA" and "CO/ALR," from 1 Grand River Court, Bramalea, Ontario (p. 1846).
66-B	A letter, dated April 14, 1977, to the Aluminum Wiring Home Owners Association, Box 424, Brampton, Ontario, from Mr. A.A. Richardson, 75 Adeline Avenue, Tottenham, Ontario (p. 1786).		
66-C	A letter, dated May 4, 1977, to the Association for Aluminum Wiring Homeowners [Aluminum Wiring Home Owners Association], Box 424, Brampton, Ontario, from Mrs. Donna Bailey, 43 Plainsman Road, Streetsville, Ontario (p. 1787).		

*Exhibit
No.*

Description

- 72 A receptacle, said to have been manufactured by Canadian General Electric Company Limited, that shows evidence of heating, from 24 Carberry Street, Brampton, Ontario (p. 1847).
- 73 A receptacle of the combination type, manufactured by Eagle Electric of Canada Ltd., from the residence of Mr. Roy, 31 Juniper Crescent, Bramalea, Ontario (p. 1848).
- 74 Two receptacles of the push-in type, manufactured by Smith & Stone Limited, from the residence of Mr. Williams, 1 Grasspoint Square, Bramalea, Ontario (p. 1849).
- 75 A receptacle of the duplex type, manufactured by Canadian General Electric Company Limited, that shows evidence of heating, from the residence of Mr. R. Silvera, Bramalea, Ontario (p. 1850).
- 76 A receptacle of the combination type, manufactured by Eagle Electric of Canada Ltd., that shows evidence of failure, from the residence of Mr. J. Allingham, 11 Crawford Drive, Brampton, Ontario (p. 1850).
- 77 Four wires whose insulation was fused together, removed from a receptacle in the residence of Mr. F. Golbeck, 343 Louis Drive, Mississauga, Ontario (p. 1851).
- 78 A receptacle of the combination type, manufactured by Circle F (Canada) Ltd., that shows evidence of heating, from the residence of Mr. C. McDonald, 16 Gleneaden Court, Bramalea, Ontario (p. 1852).
- 79 Pieces of a connector that shows evidence of heating, from a baseboard heater at 23 Glencastle Square, Bramalea, Ontario (p. 1853).
- 80 Charred pieces of a connector of the twist-on type from a water tank, and photographs of the situation as discovered by Mr. McCrindle, from 26 Hillbank Trail, Bramalea, Ontario (p. 1853).

*Exhibit
No.*

Description

- 81 Three receptacles, of different types, with wires attached, from the residence of Mr. P.T. Boychuck, 17 Davenport Court, Bramalea, Ontario. *See also* Exhibit 54 (p. 1854).
- 82 A receptacle, manufactured by Leviton Manufacturing of Canada Ltd. (p. 1856).
- 83 A circuit breaker, manufactured by Canadian General Electric Company Limited, that shows evidence of heating, from the water-heater circuit in the residence of Mr. D. Eagles, 19 Glencastle Square, Bramalea, Ontario (p. 1857).
- 84 A panel box, from the residence of Mr. and Mrs. T. Quinn, 41 Juniper Crescent, Bramalea, Ontario. *See also* Exhibit 144 (p. 1858).
- 85 A photograph of a baseboard heater, that shows evidence of heating, in the residence at 21 Goldfinch Avenue, Bramalea, Ontario (p. 1862).
- 86 A photograph of a baseboard heater, that shows evidence of heating, in the residence of Mr. and Mrs. Reid, 11 Greenbush Court, Bramalea, Ontario (p. 1863).
- 87 A receptacle of the steel-screw type, manufactured by Circle F (Canada) Ltd., with wires attached and showing evidence of heating, from the residence of Mr. P.C. Ruse, 798 Cabot Trail, Milton, Ontario. *See also* Exhibits 158, 160 (p. 1913).
- 88 A one-page document entitled, on one side, *Consumers form Aluminum Wiring Home Owners Association ...*, and, on the reverse, *The Seven Warning Signs* (p. 1960).
- 89 Two insulated aluminum wires connected at one end by a compression junction covered with plastic insulation (p. 2060).
- 90 An insulated aluminum wire butt-welded to an insulated copper wire by a compression junction covered with plastic insulation (p. 2066).

<i>Exhibit No.</i>	<i>Description</i>	<i>Exhibit No.</i>	<i>Description</i>
91	A plastic-and-metal junction block to which are attached, by binding-head screws, insulated copper and aluminum wires with lugs crimped on and insulated (p. 2068).	102-A	Two lengths of insulated aluminum and wire, to each of which lengths of copper
92	Thirteen photographs that show details of crimped metal connections (p. 2079).	102-B	wire have been attached by a crimped and insulated connection (p. 2150).
93	Twelve photographs that show details of binding-head screws and of wires connected to them (p. 2106).	103	Thirty-five photographs that show details of laboratory investigations performed by Mr. B. Jerabek on crimped and binding-head screw connections (p. 2158).
94	A transparency of a diagram that shows the cross section of a binding-head screw and wire connection (p. 2114).	104	Twenty-nine photographs that show details of laboratory investigations performed by Mr. B. Jerabek (p. 2173).
95	A transparency of a graph, dated February 1, 1977, of temperature rise above ambient versus current (p. 2114).	105	A receptacle of the hospital-grade type, manufactured by Harvey Hubbell of Canada Limited (p. 2174).
96	A transparency of a graph, dated October 8, 1977, entitled <i>Chart #1, Max. operating temp. rating. Temperature of conductor vs. load for standard aluminum building wire</i> (p. 2115).	106	A receptacle of the CO/ALR type, manufactured by Eagle Electric of Canada Ltd. (p. 2174).
97	A transparency of a graph, dated October 8, 1977, entitled <i>Chart #2, Max. operating temp. rating. Temperature of conductor vs. load for standard aluminum building wire</i> (p. 2116).	107	A receptacle of the combination type with steel binding-head screws, manufactured by Slater Electric Inc. (p. 2175).
98	A transparency of a graph, dated October 8, 1977, entitled <i>Chart #3, Temperature of conductor vs. load for standard aluminum building wire</i> (p. 2121).	108	A biographical note on Mr. J.E. Morey, Supervising Electrical Inspector, Ontario Hydro, Ottawa, Ontario (p. 2251).
99	A transparency of a graph, dated October 8, 1977, entitled <i>Temperature of conductor during overload test: Standard Aluminum Building Wire</i> (p. 2122).	109	A document, entitled <i>Inspection of Residential Wiring Installations — Ottawa Area</i> , by Messrs. J.E. Morey and K.A. Sharp (p. 2251).
100	A transparency of a graph, dated October 8, 1977, entitled <i>Temperature of conductor during overload test, Standard Aluminum Building Wire</i> (p. 2124).	110	A letter, dated August 9, 1967, from Mr. J.E. Morey, Supervising Electrical Inspector, Ontario Hydro, Ottawa, Ontario, to Mr. D.G. Third, Assistant to the Code Application Engineer, Ontario Hydro, with reference to "Fire Investigations" (p. 2259).
101	Twenty-five photographs that show details of laboratory investigations performed by Mr. B. Jerabek (p. 2150).	111	A report, dated June 7, 1965, of an electric fire at the residence of Mr. J. Taraby, 413 Third Avenue, Ottawa, Ontario (p. 2261).
		112	A report, dated April 10, 1967, of an electric fire at the residence of Mr. Ledbetter, 1025 Arnot Road, Ottawa, Ontario (p. 2262).

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- 113 A report, dated May 10, 1967, of an electric fire at the residence of Mr. G. Watts, 105-107 Stirling Avenue and 143 Armstrong Street, Ottawa, Ontario (p. 2264).
- 114 A report, dated May 20, 1967, of an electric fire at Ports Lunch, 342 Richmond Road, Ottawa, Ontario (p. 2264).
- 115 A bundle of aluminum wires, some of which show evidence of melting, from the residence of Mr. W. Bowes, Township of March, Ontario (p. 2352).
- 116 A letter, dated May 14, 1975, from Mr. J.A. Dicker, Manager, Electrical Inspection Department, Ontario Hydro, Toronto, Ontario, to Mr. J. Mlacak, Reeve, Township of March, R.R. #1, Kanata, Ontario (p. 2370).
- 117 A circuit breaker of the Stab-Lok type, manufactured by Federal Pacific Electric of Canada, from the residence of Mr. A. Sowards, 34 Selwyn Crescent, Kanata, Ontario. *See also* Exhibit 118 (p. 2416).
- 118 A receptacle, manufactured by Canadian General Electric Company Limited, from the residence of Mr. A. Sowards. *See also* Exhibit 117 (p. 2417).
- 119 A copy of *The Kanata Standard* (newspaper), dated September 30, 1977, which included information about the hearings to be held in Ottawa by the Commission of Inquiry on Aluminum Wiring (p. 2433).
- 120 A copy of *The Kanata Standard* (newspaper), dated October 14, 1977, which included information about the hearings to be held in Ottawa by the Commission of Inquiry on Aluminum Wiring (p. 2433).
- 121 A biographical note on Mr. K.A. Sharp, Journeyman Inspector, Ontario Hydro, Ottawa, Ontario (p. 2437).
- 122-A A document entitled *Miscellaneous material purporting to be reports completed after inspection of certain homes in the Ottawa area* (p. 2483).

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- 122-B A document entitled *Material from Ontario Hydro Inspection Office, Ken Sharp's Diary for the Year 1975* (p. 2483).
- 123 Two lengths of plastic-covered, multi-strand aluminum cable, from the residence of Ms. E. Clare, 66 Holmcrest Trail, Scarborough, Ontario (p. 2562).
- 124 A receptacle of the binding-head screw type, manufactured by Leviton Manufacturing of Canada Ltd., that shows evidence of heating, from the residence of Dr. K. Fitzgerald, c/o 150 Borough Drive, Scarborough, Ontario (p. 2562).
- 125 A receptacle of the binding-head screw type, manufactured by Leviton Manufacturing of Canada Ltd., that shows signs of heating, from the residence of Mrs. J. Trimmer, 2 Prince Hal Crescent, Agincourt, Ontario (p. 2563).
- 126 A receptacle of the combination type, manufactured by Eagle Electric of Canada Ltd., from the residence of Mr. H.N. Nelson, 3269 Homark Drive, Mississauga, Ontario. *See also* Exhibits 127-28 (p. 2644).
- 127 A receptacle of the binding-head screw type, manufactured by Leviton Manufacturing of Canada Ltd., from the residence of Mr. H.N. Nelson. *See also* Exhibits 126, 128 (p. 2644).
- 128 A cover plate, blackened in one place on the back, from the residence of Mr. H.N. Nelson. *See also* Exhibits 126-27 (p. 2645).
- 129 A photograph of the inside of a junction box containing wires connected by three Marr connectors, that shows evidence of heating, from the residence of Mr. A.W. Masterton, 105 Carlton Road, Townhouse 66, Unionville, Ontario. *See also* Exhibits 130-32 (p. 2704).
- 130 A photograph of the inside of the junction box from the residence of Mr. A.W. Masterton. *See also* Exhibits 129, 131-32 (p. 2704).

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- 131 A photograph of the inside of the junction box, with two Marr connectors removed, from the residence of Mr. A.W. Masterton. *See also* Exhibits 129-30, 132 (p. 2705).
- 132 The junction box, as shown in Exhibits 129 to 131, containing two cables, one with copper conductors, the other with aluminum conductors; the conductors are joined by connectors. *See also* Exhibits 129-31 (p. 2710).
- 133 A letter from Mr. W. V. Fairhall, 1036 Bridletowne Circle, Agincourt, Ontario, to Mr. R.G. Chad, authorizing Mr. Chad to act as his representative before the Commission of Inquiry on Aluminum Wiring (p. 2740).
- 134 A photograph that shows evidence of burning in a corner of a room in the residence of Mr. R.G. Chad, 1040 Bridletowne Circle, Townhouse 56, Agincourt, Ontario. *See also* Exhibits 135-43 (p. 2741).
- 135 A photograph that shows evidence of burning in a corner of a room in the residence of Mr. R.G. Chad. *See also* Exhibits 134, 136-43 (p. 2742).
- 136 A letter, dated October 7, 1977, from Mr. W.E. Wretham, Fire Chief, Scarborough, Ontario, to the Commission of Inquiry on Aluminum Wiring, regarding a fire at the residence of Mr. R.G. Chad. *See also* Exhibits 134-35, 137-43 (p. 2756).
- 137 A letter, dated June 27, 1977, from Mr. A.C. Williams, Deputy Fire Marshal, to Scarborough Fire Chief W.E. Wretham regarding a fire in the residence of Mr. and Mrs. R.G. Chad. *See also* Exhibits 134-36, 138-43 (p. 2756).
- 138 A letter, dated June 13, 1977, from Scarborough Fire Chief W.E. Wretham to P.J. Scott Company Limited, Suite 1126, 40 University Avenue, Toronto, Ontario, regarding a fire at the residence of Mr. and Mrs. R.G. Chad. *See also* Exhibits 134-37, 139-43 (p. 2757).

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- 139 A letter, dated June 29, 1977, from Scarborough Fire Chief W. E. Wretham to P.J. Scott Company Limited, Suite 1126, 40 University Avenue, Toronto, Ontario, regarding a fire at the residence of Mr. and Mrs. R.G. Chad. *See also* Exhibits 134-38, 140-43 (p. 2757).
- 140 A memorandum, dated July 5, 1977, from Scarborough Fire Chief W.E. Wretham to Controller Joyce Trimmer regarding a report on the fire at the residence of Mr. and Mrs. R.G. Chad. *See also* Exhibits 134-39, 141-43 (p. 2758).
- 141 A report, dated March 23, 1977, by Scarborough Fire Department, Scarborough, Ontario, referring to a fire at the residence of Mr. R.G. Chad, at the address given as 1040 Bridletowne Circle, Unit 56, Agincourt, Ontario. *See also* Exhibits 134-40, 142-43 (p. 2758).
- 142 A report, dated March 28, 1977, by Ontario Hydro, referring to a fire at the residence of Mr. R.G. Chad. *See also* Exhibits 134-41, 143 (p. 2758).
- 143 A memorandum, undated, from Scarborough Fire Chief W.E. Wretham replying to an inquiry made on May 2, 1977, by Controller J. Trimmer, referring to the fire at the residence of Mr. R.G. Chad, at the address given as 1040 Bridletowne Circle, Unit 56, Agincourt, Ontario. *See also* Exhibits 134-42 (p. 2759).
- 144 A letter, dated November 16, 1977, to the Aluminum Wiring Home Owners Association from Mr. T. Quinn, 41 Juniper Crescent, Bramalea, Ontario, regarding a fire on October 2, 1976; and a Brampton Fire Department Occurrence Report attached. *See also* Exhibit 84 (p. 2782).
- 145 A receptacle of the push-in type, manufactured by Smith & Stone Limited, from the residence of Mr. D. Clark, 27 Lawnmere Crescent, Agincourt, Ontario (p. 2815).

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- 146 A letter and a document, both dated November 17, 1977, from Controller J. Trimmer to the Commission of Inquiry on Aluminum Wiring (p. 2840).
- 147 A receptacle of the push-in type, manufactured by Eagle Electric of Canada Ltd., that shows evidence of failure, from the residence of Mr. M. Parker, 95 Pebblehill Square, Scarborough, Ontario. *See also* Exhibit 148 (p. 2937).
- 148 A letter, dated March 29, 1977, from Mr. M. Parker to the Home Owners Wiring Association [Aluminum Wiring Home Owners Association], Box 424, Brampton, Ontario, regarding electric-equipment failures at his residence at the address given as 95 Pebble Hill Dr., Agincourt, Ontario. *See also* Exhibit 147 (p. 2947).
- 149 A booklet, entitled *This is EEMAC*, describing the Electrical and Electronic Manufacturers Association of Canada (p. 3056).
- 150 A thermostat, from the residence of Mr. L. Mann, 10 Gleneaden Court, Bramalea, Ontario (p. 3099).
- 151 A CO/ALR receptacle with steel binding-head screws, bearing the CSA approval emblem; that shows evidence of heat damage, from the residence of Mr. G. Baliseh, 25 Gleneaden Court, Bramalea, Ontario. This exhibit was described incorrectly in the transcript as a "baseboard heater twist on connector" (p. 3121).
- 152 A biographical note on Mr. R.T. Whiteford, Supervising Electrical Inspector, Brampton Area, Ontario Hydro (p. 3181).
- 153 A document entitled *Inspection of Residential Wiring Installations, Brampton Area*, by Mr. R.T. Whiteford, Ontario Hydro (p. 3181).
- 154 A letter, dated December 1, 1977, and attached map of Bramalea from Mr. R.F. Smith, Ontario Hydro, to Miss A. Manzer, regarding inspection of residential wiring in Brampton (p. 3214).

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- 155 A document entitled *Summary of Aluminum Wire Hot Line in Brampton as of September 14, 1977*, by Mr. R.T. Whiteford, Ontario Hydro (p. 3259).
- 156 A document entitled *Summary of Aluminum Wire Hot Line in Brampton as of December 9, 1977*, by Mr. R.T. Whiteford, Ontario Hydro (p. 3260).
- 157 A document entitled *Smith & Stone Receptacle Cat. No. 1-1174*, dated July 29, 1974, by Mr. G.E. Davidson, Ontario Hydro (p. 3260).
- 158 A copy of a report by Mr. R.T. Whiteford, Ontario Hydro, on the fire on December 27, 1976, at the residence of Mr. P.C. Ruse, 798 Cabot Trail, Milton, Ontario. *See also* Exhibits 87, 160 (p. 3273).
- 159 No exhibit entered.
- 160 A report by Mr. R.T. Whiteford, Ontario Hydro, dated December 27, 1976, referring to an electric fire at the residence of Mr. P.C. Ruse, 798 Cabot Trail, Milton, Ontario. *See also* Exhibits 87, 158 (p. 3426).
- 161 A letter, dated December 14, 1977, from Mr. B.L. Eadie, Eadie Electric Contracting Limited, 32 Barkwood Court, Brampton, Ontario, to Mr. L. Halbach, Aluminum Wiring Home Owners Association, Box 424, Brampton, Ontario, regarding replacement of receptacles (p. 3461).
- 162 A document entitled *Inspection of Residential Wiring Installations, Central Region*, by Mr. L. Stoch, Ontario Hydro (p. 3484).
- 163 A biographical note on Mr. L. Stoch, Electrical Inspection Superintendent, Central Region, Ontario Hydro, Willowdale, Ontario (p. 3484).
- 164 A booklet entitled *Your Guide to Electric Home Heating*, by Ontario Hydro (p. 3504).
- 165 A document entitled *The Consumer Special Issue, Number 77-15*, by Canadian Standards Association (p. 3505).

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166	An addendum to the document entitled <i>Inspection of Residential Wiring Installations, Central Region</i> . See also Exhibit 162 (p. 3510).	174	A report by Ontario Hydro, dated August 12, 1977, referring to an electric fire on August 11, 1977 at the residence of Mr. R. Rosen, 115 Henderson Avenue, House 9, Thornhill, Ontario (p. 3771).
167	A report, undated, by Mr. L. Stoch, Ontario Hydro, referring to a fire on April 29, 1977, at the residence of Mr. O. Kapur, 3 Gladstone Square, Bramalea, Ontario. See also Exhibit 233 (p. 3531).	175	A document, dated January 9, 1978, entitled <i>Legal Challenge of the Terms of Reference for the Commission of Inquiry on Aluminum Wiring</i> , by the Concerned Consumers Foundation Inc., Ottawa, Ontario (p. 3805).
168	A document, dated May 6, 1977, entitled <i>Workmanship by Electrical Contractors</i> , written by Mr. L. Stoch, Ontario Hydro (p. 3551).	176	A copy of An Act Respecting Weights and Measures, Canada, April 7, 1971 (p. 3805).
169	A document, by Mr. L. Stoch, analysing telephone calls received by the "Brampton (Ontario) Hydro Hot Line" (p. 3559).	177	A document, undated, entitled <i>Residential Home Circuit Wiring and Energy Conservation, Safety and Performance</i> , by the Concerned Consumers Foundation Inc., Ottawa, Ontario (p. 4024).
170	A document listing complaints regarding electric devices, appliances, etc., which were received by Brampton Hydro, and summarizing the responses made by Ontario Hydro (p. 3560).	178	A report entitled <i>Record of Tests Requested by Dr. K.D. Srivastava</i> , conducted by the Canadian Standards Association, Rexdale, Ontario (p. 4128).
171	A report by Ontario Hydro, dated March 7, 1977, referring to an electric fire on March 4, 1977 at the residence of Mr. R. Bailey (deceased), 2470 Woburn Crescent, Oakville, Ontario. See also Exhibit 238 (p. 3645).	179	A document entitled <i>An Overview of CERTICO, The ISO Committee on Certification</i> , by Mr. J.E. Kean, Canadian Standards Association (p. 4130).
172	A report by Ontario Hydro, dated November 15, 1977, referring to an electric fire on November 14, 1977 at the residence of Mr. R. Astles, 10 Mosley Street, Aurora, Ontario. See also Exhibit 172-A (p. 3657).	180	A circuit breaker of the steel-screw type, manufactured in Italy (p. 4188).
172-A	A piece of fabric; a face plate; a receptacle, manufactured by Leviton Manufacturing of Canada Ltd.; two photographs of wall board — all of which show evidence of heating — and reports on an electric fire on November 14, 1977, at the residence of Mr. R. Astles. See also Exhibit 172 (p. 3770).	181	A thermostat, manufactured by Canadian General Electric Company Limited; and a letter, dated December 22, 1977, from Canadian General Electric Company Limited to Canadian Standards Association (p. 4266).
173	A document entitled <i>Recorded Occurrences Involving Electrical Energy from May 1, 1977, to October 31, 1977</i> (p. 3675).	182	A document, dated September 29, 1976, entitled <i>Effect of appliance starting currents on residential wiring connections</i> (No. 76-387-K), by Mr. R.L. Hicks, Ontario Hydro (p. 4603).
		183	A letter, dated March 14, 1975, from Mr. J.A. Dicker, Ontario Hydro, to Mr. A. Zdanowicz, Ontario Housing Corporation (p. 4696).

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- 184 A letter, dated May 15, 1975, from Mr. A. Zdanowicz, Ontario Housing Corporation, to Mr. J.A. Dicker, Ontario Hydro, with the heading "Aluminum Wiring in Residential Construction" (p. 4703).
- 185 A letter, dated May 26, 1976, from Mr. A. Zdanowicz, Ontario Housing Corporation, to Mr. R.L. Hicks, Ontario Hydro (p. 4711).
- 186 Three documents, entitled, respectively, *Electrician, An Apprentice Training Profile*, by Ontario Ministry of Colleges and Universities; *Construction and Industrial Electrician*, by Canada Manpower and Immigration; and *An Analysis of the Electrical Trade*, by Ontario Ministry of Colleges and Universities (p. 4863).
- 187 A document, dated December 5, 1977, entitled *A review and evaluation of the properties of electrical contacts involving aluminium and copper*, by Dr. R.S. Timsit, Aluminum Company of Canada, Ltd., Research Centre, Kingston, Ontario (p. 4868).
- 188 A report, dated January 23, 1978, entitled *Alcan Laboratory Test Program, Branch Circuit Wiring*, by Mr. K.J. Smith and Mr. G.D. Papazian (p. 4868).
- 189 A report, dated January 19, 1978, entitled *Examination of Aluminium Wired Receptacles after 28 Years Service in Arvida Houses*, by Mr. K.J. Smith and Dr. R.S. Timsit (p. 4868).
- 190 A report, dated December 12, 1977, entitled *Alcan House Wiring System Simulator*, by Alcan Canada Products Limited, Toronto, Ontario (p. 4869).
- 191 A chart illustrating the organization of the Customer Service Division, Ontario Hydro (p. 5170).
- 192 A biographical note on Mr. F.P. Kehoe, Supervising Electrical Inspector, London Inspection District, Ontario Hydro (p. 5267).

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- 193* A document, dated January 1978, entitled *Inspection of Residential Wiring Installations, London Inspection District*, by Mr. F.P. Kehoe (p. 5267).
- 193* A receptacle of the push-in type, manufactured by Smith & Stone Limited and marked "Cu-Al," with aluminum wires attached, from the residence of Mr. & Mrs. P. Sherriff, 18 Dudley Street, Westminster Park, London, Ontario (p. 5281).
- 194 A biographical note on Dr. M. Léger, Ph.D., Engineer, Metallurgy Section, W.P. Dobson Research Laboratory (Mechanical Research Department), Ontario Hydro (p. 5467).
- 195 A document entitled *Metallurgical Studies on Aluminum Wire Connections*, by Dr. M. Léger (p. 5467).
- 196 A form letter from Messrs. J. Murphy and G. Heighington, on behalf of the Aluminum Wiring Home Owners Association, Brampton, Ontario, to many electrical contractors in the Greater Toronto area (p. 5510).
- 197 A completed questionnaire from Electrical Industrial Development (London) Ltd., 2475 Dundas Street, London, Ontario, to Aluminum Wiring Home Owners Association, Box 424, Brampton, Ontario (p. 5510).
- 198 A document entitled *1976 Fire Losses in Ontario*, by the Office of the Fire Marshal (p. 5561).
- 199 A computer print-out, produced by Mr. A.C. Williams, Deputy Fire Marshal, Ontario Fire Marshal's Office, Toronto, Ontario, referring to occurrences with aluminum wiring between January 1, 1977 and November 30, 1977 (p. 5567).
- 200 A computer print-out, produced by Mr. A.C. Williams, Deputy Fire Marshal, referring to occurrences with copper wiring between January 1, 1977, and November 30, 1977 (p. 5567).

*Two exhibits were numbered 193.

<i>Exhibit No.</i>	<i>Description</i>
201	A document entitled <i>Aluminum Wiring Fires Reported and Copper Wiring Fires Reported for 1976 and 1977 up to and including November</i> , prepared by Mr. A.C. Williams, Deputy Fire Marshal (p. 5568).
202	A document entitled <i>1976 Fire Reports, Aluminum Wiring Present</i> , prepared by Mr. A.C. Williams, Deputy Fire Marshal (p. 5572).
203	A document entitled <i>1977 Fire Reports in Buildings — Aluminum Wiring Was Present</i> , prepared by Mr. A.C. Williams, Deputy Fire Marshal (p. 5572).
204	Fire reports on houses wired with aluminum, prepared by the Fire Marshal's Office (p. 5589).
205-A	Three pamphlets regarding home safety,
205-B	issued by the Office of the Fire Marshal,
and	Ministry of the Solicitor General, Ontar-
205-C	io (p. 5602).
206	A letter, dated June 30, 1976, from Mr. M.A. Lamothe of Smith & Stone Limited, to the Advisory Council on Electrical Safety, Canadian Standards Association (p. 5746).
207	A letter, dated October 17, 1977, from Mr. J.R. Miller, Fire Chief, City of Mississauga, Ontario, to Mr. D. Hawkins, Resource Centre, Scarborough, Ontario (p. 5700).
208	A document entitled <i>EEMAC Technical Report on Residential Branch Circuit Terminations Using Aluminum Wire</i> (p. 5772).
209	A document entitled <i>Technical Considerations Relating to Performance Reliability of Aluminum in Branch Circuit Wiring and Comparisons with Copper</i> , prepared by the staff of the Commission of Inquiry on Aluminum Wiring (p. 5799).
210	A connector of the clam type, manufactured by Thomas & Betts Limited (p. 5988).

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211	A document entitled <i>Clam Connector, Newest Way to Quickly Pigtail or Tap</i> , by Thomas & Betts Limited (p. 5991).
212	A connector of the clam type, manufactured by Thomas & Betts Limited, connecting an insulated stranded-copper wire and an insulated aluminum wire (p. 5992).
213	A connector of the clam type, manufactured by Thomas & Betts Limited, connecting two wires (p. 5993).
214	A connector of the clam type, manufactured by Thomas & Betts Limited, connecting two wires (p. 5994).
215	A letter, dated June 19, 1973, from Mr. G. Sutherland, Inspector, Canadian Standards Association, to Circle F Industries, Trenton, New Jersey, U.S.A., regarding the use of steel terminal screws in electric devices (p. 6047).
216	A factory inspection report, dated April 26, 1974, from Canadian Standards Association, to Circle F (Canada) Ltd., 1840 Ellesmere Road, Scarborough, Ontario, regarding the fact that the use of steel terminal screws is unacceptable (p. 6049).
217	A document, entitled <i>Report from the Wiring Device Section to the Chairman, Construction and Industrial Equipment Division of Electrical and Electronic Manufacturers Association</i> (p. 6068).
218	A document, dated April 25, 1977, from Mr. T.N. Heilman to Mr. R. Noffke, entitled <i>Consumer Product Safety Commission Review of Homes Wired with Copalum</i> . (p. 6105).
219	A document, dated May 1974, entitled <i>Terminals and Splices</i> , by AMP Incorporated, Harrisburg, Pennsylvania, U.S.A. (p. 6108).
220	A document, dated August 1971, entitled <i>Terminals and Splices</i> , by AMP Incorporated, Harrisburg, Pennsylvania, U.S.A. (p. 6108).

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- 221 A letter, dated July 19, 1977, from Mr. D.W. Fleck, Clerk, Village of Tottenham, Ontario, to Miss A. Manzer, regarding the compulsory use of copper wire in the Village of Tottenham (p. 6264).
- 222 Seven letters from various insurance adjusters to Miss A. Manzer, regarding a lack of experience or problems with aluminum wiring (p. 6292).
- 223 Two letters to Miss A. Manzer, dated July 25 and 21, 1977, from, respectively, Insurance Bureau of Canada and Underwriters' Laboratories of Canada, regarding a lack of knowledge of whether or not aluminum wiring constitutes a safety hazard (p. 6293).
- 224 Twenty-six letters to Miss A. Manzer from various Canadian insurance companies regarding their experience that aluminum wiring is not considered a safety hazard; only two companies consider such wiring for underwriting purposes (p. 6293).
- 225 Twelve letters to Miss. A. Manzer from various manufacturers of electric devices (p. 6295).
- 226 Thirteen letters to the Commission of Inquiry on Aluminum Wiring from the electric-inspection authorities of all provinces except Ontario and from federal inspectors, regarding their experience with wiring. All letters indicated little trouble with aluminum wiring except when improperly installed, in which case it is less forgiving than copper wiring (p. 6296).
- 227 Nine letters to Miss A. Manzer from various electrical contractors, regarding the use of wire. Five contractors stated that aluminum wire is a cause of trouble in a residential system (p. 6296).
- 228 Thirteen letters to Miss A. Manzer from various community colleges in Ontario, regarding the use of copper wire for teaching purposes because of the extra difficulties encountered with aluminum wire (p. 6297).

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- 229 Six letters to Miss A. Manzer from various municipal fire departments, regarding fire incidents where aluminum wiring was present (p. 6298).
- 230 A letter, dated June 24, 1977, from Mr. R.G. Swick, Fire Chef, West Lincoln Volunteer Fire Department, Smithville, Ontario, to Miss A. Manzer, regarding a fire incident where aluminum wiring was involved (p. 6298).
- 231 Nine letters to Miss A. Manzer from various municipal fire departments, regarding the lack of problems with aluminum wire in their respective areas (p. 6298).
- 232 Four letters to Miss A. Manzer from various municipal fire departments, each of which recorded the fact that no separate records for aluminum wire were kept (p. 6298).
- 233 A report, by City of Brampton Fire Department, regarding a fire at the residence of Mr. O. Kapur, 3 Gladstone Square, Bramalea, Ontario. *See also* Exhibit 167 (p. 6299).
- 234 A list of occurrences, supplied by Fire Chief M.M. Smith, Town of Markham, Markham, Ontario (p. 6337).
- 235 A map of the area under the jurisdiction of Fire Chief M.M. Smith, Markham, Ontario (p. 6337).
- 236 A brief of Dr. M. Braunovic, Senior Scientist, IREQ, Institut de Recherche de l'Hydro-Québec, Varennes, Quebec (p. 6355).
- 237 A summary, dated February 1978, entitled *Alcan Design Homes Limited*, by Mr. K. Cross (p. 6422).
- 238 A fire-investigation report, undated, of a fire on March 4, 1977 in the residence of Mr. R.M. Bailey (deceased), 2470 Woburn Crescent, Oakville, Ontario. *See also* Exhibit 171 (p. 6461).
- 239 A fire-investigation report, undated, of a fire on March 22, 1977 in the residence of Mr. C. Belasko, 2446 Woburn Crescent, Oakville (p. 6462).

<i>Exhibit No.</i>	<i>Description</i>
240	A document identical to Exhibit 67-A. See Exhibit 67-A for a description (p. 6512).
241	A graph, by Dr. U. Franklin (p. 6578).
242	A photomicrograph, of 1,000x magnification, that shows an interface of aluminum and brass; presented by Dr. M. Léger, Ontario Hydro (p. 6578).
243	A brief, dated October 12, 1977, submitted by Mr. J. Murphy, Aluminum Wiring Home Owners Association, Brampton, Ontario (p. 6596).
244	A brief, dated October 12, 1977, submitted by Mr. G. Heighington, Aluminum Wiring Home Owners Association, Brampton, Ontario (p. 6596).
245	Six documents, dated November 1977, each entitled <i>Note of Meeting Regarding Aluminum Wire</i> , regarding the experience with aluminum wiring in Nova Scotia (p. 6596).

<i>Exhibit No.</i>	<i>Description</i>
246	Two letters, dated December 16, 1977 and January 5, 1978, from Lang, Michener, Cranston, Farquharson, and Wright, P.O. Box 10, First Canadian Place, Toronto, Ontario, over the signature of Mr. B.C. McDonald (p. 6597).
247	A letter, dated February 20, 1978, from Mr. W.D. Degaust, Department of Labour, Province of Alberta, and enclosed pamphlets and bulletins (p. 6598).
248	Two letters, dated, respectively, February 3, 1978 and February 7, 1978, from Mr. A.R. Luck, Chief Electrical Inspector, Province of British Columbia (p. 6598).
249	Bibliography compiled by the Commission of Inquiry on Aluminum Wiring. See Section 3.3 (p. 6599).
250	Four brochures and leaflets from Canada Wire and Cable Company, Limited and Alcan Canada Products Limited, Toronto, Ontario (p. 6600).

3.2 Glossary

Definitions and explanations for the terms in this glossary have been prepared for the general reader. More technical information on the terms can be found in standard specialized handbooks.

Å, angstrom.

abrasive, a substance that is used to grind down, polish, etc. Abrasive action may be instrumental in interfering with electric contacts.

absolute (Kelvin) temperature, temperature that is measured on the Kelvin scale. In this scale 0° represents *absolute zero*, the lowest attainable temperature.

	Kelvin	Celsius	Fahrenheit
steam point	373°	100°	212°
ice point	273°	0°	32°
absolute zero	0°	-273°	-460°

absolute zero, *see* absolute (Kelvin) temperature.

absorption, a taking up and becoming part of; a taking in and holding.

accelerated life test, a test to determine in a sensible time the amount of deterioration that occurs in equipment, a device, etc. when certain factors are increased above normal operating values. In such equipment as a cable or connector, the factors increased might be voltage, current, temperature, etc. This kind of test affords in a relatively short time some estimate of the probable life of the test item under normal operating conditions.

accelerated reliability test, a test to determine the stress response of a device, etc. by subjecting the item to stress greater than that normally applied. The test may be done in such a way either to reduce the time required to determine the response or to increase the response in a specified time. The reaction mechanisms must not be altered by the acceleration of the test.

acceptance test, *see* approval test.

accuracy, 1. freedom from errors or mistakes. → **accuracy, precision**, a measurement expressed in figures to six places of decimals

(e.g., 17.411652 metres) is more precise than figures to four decimal places; an error in the last two decimal places would make the four-place figure more accurate. 2. Conformity with an accepted standard.

ACM, aluminum-conductor material.

ACSR, aluminum cable steel reinforced.

activation, of a metal, the changing of the surface from an inactive, or passive, state to a chemically active condition. *Contrast with* passivation.

activation energy, the energy required to begin a metallurgical reaction, such as diffusion, or a chemical reaction.

acuity, notch, *see* notch acuity.

adsorption, the collecting of a gas, liquid, etc. in a layer on the surface of a solid material.

A-fritting, the formation of a conducting channel, or a-spot, through an undamaged film (e.g., oxide, sulphide). B-fritting may subsequently widen this channel. *See also* B-fritting.

age hardening, in an alloy, hardening that occurs over a period of time when precipitation of a phase or phases within the alloy is accelerated by an increase in temperature.

ageing, of a metal or alloy, a change in properties that generally progresses slowly at room temperature and more quickly at higher temperatures. *See also* artificial ageing; natural ageing; overageing; quench ageing; strain ageing.

agitation, thermal, *see* thermal agitation.

AIEE, American Institute of Electrical Engineers. *See also* IEEE.

Al, aluminum.

alive electric system, wire or equipment that carries an electric current or that is electrically charged; live electric system. The word *alive* is used sometimes instead of *current-carrying*, a longer but self-explanatory term.

alloy, a solid solution or mixture consisting of a combination of two or more metals or of a metal and a non-metal. *See also* eutectic alloy; eutectoid alloy.

alloy plating, a process of electroplating an alloy on the surface of another substance.

alloy steel, a type of steel containing alloying elements (other than carbon and small amounts of manganese, silicon, sulphur, and phosphorus) that result in desired mechanical or physical properties.

alloying element, a chemical element that is added to, and becomes part of, a solvent to alter the mechanical or physical properties of the solvent.

alternating current, an electric current that reverses its direction at regular intervals and that has alternate positive and negative signs. The normal household current is 60 cycles of alternating current per second.

alternating-current phase, *see* phase, circuit.

Al₂O₃, alumina, an oxide of aluminum.

alumina, aluminum oxide, Al₂O₃, which has a melting point of 2020°C.

aluminium, the spelling of aluminum that is preferred in Great Britain, France, and other European countries.

aluminum-alloy conductor, an aluminum alloy used for conducting electric current.

aluminum bronze, *see* bronze (def. 3).

aluminum cable steel reinforced, a conductor of electric current, usually consisting of aluminum wires surrounding steel wires; aluminum conductor steel reinforced; ACSR.

aluminum conductor, an electric conductor made of EC grade of aluminum.

aluminum conductor steel reinforced, *see* aluminum cable steel reinforced.

aluminum, EC, *see* EC aluminum.

aluminum oxide, 1. at room temperature, in a relatively dry atmosphere, an amorphous aluminum oxide forms on the surface of aluminum. 2. a crystalline oxide, which forms at higher temperatures. 3. alumina.

ambient, surrounding.

ambient conditions, conditions (e.g., temperature, pressure, humidity) that are characteristic of an environment.

ambient temperature, the temperature of the surroundings. *See also* limiting ambient temperature.

American wire gauge, a system of designating sizes of wires; AWG.

amorphous, non-crystalline.

ampacity, the amount of electric current that a wire or cable can carry under specific thermal conditions. Ampacity is expressed in amperes.

ampere, the SI unit of measurement of the strength of an electric current. One volt can send one ampere of current through a resistance of one ohm.

anelastic, of a metal or alloy, not resuming completely its normal shape after the removal of a deformation-causing load.

angstrom, a unit of measurement of extremely short lengths, equal to one/ten-thousand millionth of a metre (10⁻⁸ cm.); Å.

anion, a negatively charged ion. *See also* cation.

anisotropic, having different properties in different directions. For example, the longitudinal and transverse mechanical properties in aluminum wire are different.

annealing, a process of heating metals, glass, etc. to, and holding at, a suitable temperature, then cooling at a suitable rate. Annealing is done to reduce hardness or to obtain desired physical or mechanical properties. *See also* full annealing; quench annealing; recrystallization annealing.

anode, the electrode that collects electrons and supplies charge to a circuit. The anode corrodes when immersed in an electrolytic solution. *See also* cathode.

anodize, treat a metallic surface to produce an oxide film.

apparent contact area, *see* contact area, apparent.

appliance, electric, a machine, tool, or other device — usually complete in itself and available in prepackaged, standardized forms — that functions by converting electric energy into another form of energy, such as heat or mechanical motion. Electric appliances, generally used in the home, include:
air conditioner
baseboard heater

beaters (food)
 blender (food)
 can opener
 clock
 coffee maker
 curling iron
 dishwasher
 dryer (clothing, etc.)
 fan
 freezer
 frying pan
 grill or oven, portable
 hair dryer
 heater, portable
 home-workshop tools
 (e.g., drill)
 hot plate
 ice crusher
 ice-cream maker
 iron
 kettle
 knife
 lawn mower
 radio receiver
 record player
 refrigerator
 shaver
 stove
 sun lamp
 television receiver
 timer
 toaster
 toothbrush
 waffle iron
 washing machine
 water heater

approval test, a controlled test to assess the performance characteristics of an electric appliance, component, etc.; acceptance test.

approved, 1. of electric equipment, authorized under Section 2 of the Canadian Electrical Code for use, installation, sale, offer for sale, etc. 2. of other items, methods, etc., authorized by an acceptable certification agency for use, sale, etc.

arc, 1. a discharge of electric current between two electrodes, made visible by a luminous glow. 2. a discharge of electric current through a gas.

architectural bronze, *see* bronze (def. 4).

Arrhenius equation, an equation that relates the temperature and the energy required to activate atom movement, e.g., as for diffu-

sion; exponential function. *See also* activation energy.

The general form of the equation is:

$$k = Ae^{-E_a/RT}$$

where

k = the rate constant or specific reaction rate or reaction constant

A = a constant related to the frequency of molecules crossing a potential barrier

E_a = the empirical activation energy per mole of reaction

R = gas constant

T = the absolute temperature

artificial ageing, the process of ageing above room temperature. Precipitation heat treatment is one process of artificial ageing. *See also* ageing.

asperity, one of the peaks in a series of peaks and valleys that make up a nominally flat contact surface.

a-spot, a metal-to-metal contact point, generally considered as a circle with radius a .

ASTM, American Society for Testing Materials.

atomic per cent, the number of atoms of a chemical element in 100 representative atoms of a substance, often written a/o .

austenitic, of steel alloys, having the property of not hardening when quenched.

austenitize, heat steel alloys to form an austenitic structure.

AWG, American wire gauge.

backbox, *see* outlet box.

backwiring, the pushing of wire leads into slots in the back of a receptacle, where a spring holds the leads in place; quick wiring; push-in connection.

barrel connector, a type of pigtail connector in which a metal sleeve is slipped over and secured, by means of a set screw, to conductors in order to make a joint; tunnel-type connector.

base plate, *see* terminal plate.

basic metal, the original metal or alloy; the original metal to which one or more coatings are applied.

Bauschinger effect, of polycrystalline metal, the reduction in yield strength resulting from plastic deformation of the metal — caused by stress applied in one direction — when the direction of the applied stress is reversed.

bendability, the relative property of conductors, made from different alloys or metals, that permits formation into various shapes (e.g., planar wire loop).

bend test, a test to determine the relative ductility, soundness, and toughness of metal. The metal may be in a variety of forms: sheet, strip, plate, or wire. The test usually consists of bending the metal specimen over a cylinder of specified diameter, through a specified angle for a given number of cycles.

beryllium bronze, *see* bronze (def. 3).

B-fritting, the enlarging of a contacting channel, or a-spot, when the contact temperature rises enough to cause metal softening and plastic flow. *See also* A-fritting.

binding head, *see* screw.

bolted connection, *see* connection, bolted.

bolted joint, *see* connection, bolted.

Boltzmann's constant, a thermal-energy coefficient (1.380×10^{-23} joule per degree Kelvin), usually designated by the letter *k*.

bond, bind firmly by pressing two contacting bodies together. *See also* sintering.

boundary phase, *see* phase, boundary.

box, *see* outlet box.

box connector, a connector whose outer covering secures a cable where it enters an enclosure, such as an outlet box.

box, service, *see* service box.

branch circuit, general-purpose, 1. an electric circuit that provides a number of outlets for lighting fixtures, appliances, etc. 2. in a panelboard, the part of a wiring installation between the final overcurrent device, which protects the circuits, and the outlets.

branch circuit, lighting, *see* lighting branch circuit.

branch circuit, special, in a panelboard, an electric circuit that connects the final overcurrent device to only one outlet or to several outlets of the same type (e.g., baseboard-heater circuit).

brass, an alloy of copper and zinc.

breaking, strength, *see* strength breaking.

break-off tab, on some duplex receptacles, a thin metal strip or bridge that normally carries electric current from one half of the receptacle to the other, but that can be removed to separate the halves electrically.

breathing of contact, *see* contact, breathing of.

Brinell hardness test, a test to determine the hardness of a material by forcing a hard-steel or carbide ball of specified diameter into the material under a given pressure. The degree of hardness is measured by the diameter of the indentation.

brittle, easily broken; broken with a small amount of energy; fracturing with a snap. A crack in a brittle material spreads without appreciably altering the shape of the material. *See also* notch brittleness.

bronze, 1. usually, an alloy of copper and tin, with or without small proportions of other elements, such as zinc and phosphorus. 2. an alloy of copper and other elements, with a relatively low quantity of zinc, such as manganese bronze (copper-zinc, with manganese, tin, and iron) and leaded tin bronze (copper-lead, with tin and, sometimes, zinc). 3. an alloy of copper and another element, such as aluminum bronze (copper-aluminum), silicon bronze (copper-silicon), and beryllium bronze (copper-beryllium). 4. a trade term for certain copper-base alloys, actually brasses, such as architectural bronze (copper-zinc-lead) and commercial bronze (copper-zinc).

burn-down, *see* burn-out.

burning, permanently damaging a metal or alloy by overheating, which causes either partial melting or intergranular oxidation. *See also* overheat.

burn-out, in an electric connection, a failure that is caused by overheating; burn-down.

bus, *see* bus bar.

bus bar, a heavy, rigid, metal conductor, usually of copper or aluminum, for high-amperage electric circuits; bus.

C, carbon.

cable, an assembly of multiple wires bundled together and usually enclosed in a sheath or outer jacket. A cord or stranded wires may be called a *small cable*. *See also* Table 44.

cable, flexible, *see* Table 44.

cable, non-metallic sheathed, a cable that has a non-metallic sheath or outer covering. The cable usually contains two or three electric conductors when it is used for residential branch-circuit wiring.

cable, small, *see* cable.

capillary attraction, adhesion and cohesion combined to cause any liquid to flow, even against gravity, between very closely spaced solid surfaces.

carbon steel, a kind of steel in which carbon is the major element alloyed with iron. Carbon steel may also contain silicon, sulphur, phosphorus, and manganese.

cartridge fuse, a fuse that has a cylindrical body with metal contacts at each end. The fuse element is enclosed in the body and is not visible. The fuse is used normally in residential circuits that require protection greater than 30 amperes, such as an electric-stove circuit or the main supply fuses.

cast iron, an alloy of iron, silicon, and carbon (some of which is in the form of free graphite).

casting, the process of pouring metal into moulds of specific forms or shapes, such as ingots, and allowing the metal to solidify.

catastrophic failure, *see* failure.

cathode, the electrode that receives electrons from the external circuit. The cathode in an electrolytic solution does not corrode. *See also* anode.

cation, a positively charged ion. *See also* anion.

centre-line average, a measure of surface roughness; the root-mean-square deviation of the surface profile from its average line; C.L.A.

Charpy test, a test to determine the impact strength of a metal. A pendulum falls on and breaks the specimen, which is supported at both ends as a simple beam. The metal's *impact strength* or *notch toughness* is measured by the energy absorbed in breaking the unnotched or notched specimen, as determined by the decrease in the pendulum's subsequent rise.

chemisorption, the retaining of the molecules of a liquid or gas on the surface of a solid by a chemical force.

circuit, a conductor or arrangement of conductors through which an electric current flows. *See also* branch circuit; open circuit; receptacle circuit; short circuit; split-receptacle circuit.

circuit breaker, an electromechanical device that, without injury to itself, can open automatically a current-carrying circuit under either an overload or a short-circuit condition. After breaking the circuit, the device can be reset.

circuit diagram, a sketch or plan that shows the arrangement of the components of an electric circuit.

circuit phase, *see* phase, circuit.

circular mil, a unit of area used in measuring large wires. There are 1,974 circular mils in a square millimetre. The cross-sectional area of a circle is equal to the square of its diameter in mils.

C.L.A., centre-line average.

clad metal, metal consisting of two or more layers of metals bonded by such processes as co-rolling, welding, casting, chemical deposition, or electroplating; protective coating.

clamping screw, *see* screw.

clean contact, a contact through which electric current flows between surfaces that have been cleaned, either chemically or mechanically, before being joined.

CO/ALR, copper/aluminum revised, a specific series of tests required for certification of branch-circuit components to be connected to aluminum and copper conductors.

coarsening, *see* grain growth (def. 2).

cold welding, joining metallic solids under pressure but without added heat.

cold working, deforming a metal or alloy below its recrystallization temperature.

commercial bronze, *see* bronze (def. 4).

component, 1. one of the elements in an alloy. 2. one of the least number of substances that can be used to completely define a chemical, etc. system. 3. a part of a vector in a system of co-ordinates. 4. one of the parts of an electric device.

composite material, 1. a material that consists of two or more distinct materials. 2. a structural material composed of different alloys or plastics and strengthening agents.

compound, a combination of two or more elements in specific proportions. *See also* electron compound; intermetallic compound; joint compound.

compression lug, a type of crimp connector that has a sleeve for terminating the conductor and a flat plate, or lug, in which bolt holes are drilled.

conduction electrons, electrons that have sufficient energy to serve as carriers of negative charge.

conductivity, the ability to transfer electric or thermal energy along a potential gradient; heat conduction. *See also* thermal conductivity.

conductor, 1. a substance, etc. that transmits electricity. 2. a wire, cable, etc. that can carry an electric current. *See also* aluminum-alloy conductor; aluminum cable steel reinforced; aluminum conductor; copper conductor; line conductor; neutral conductor; phase conductor; rope-lay conductor; semiconductor; service.

connectability, the relative ability of a conductor to establish and maintain a satisfactory electric connection.

connection, 1. the joining together of electric conductors or the joining of a conductor to a terminal. 2. of electric conductors, or of a conductor and a terminal, the state of being joined; joint. *See also* termination.

connection, bolted, a joining of two or more electric conductors that are secured by bolts to maintain pressure; bolted joint.

connector, a device used to join electric conductors together. *See also* barrel connector; box connector; crimp connector; knife-edge connector; pigtail connector; pressure-wire connector; set-screw connector; twist-on connector; wire connector; wire-nut connector.

constituent, 1. a component of a chemical substance. Oxygen is a constituent of aluminum oxide. 2. of an alloy, a distinguishable phase or combination of phases in a characteristic pattern of the microstructure.

constitution diagram, *see* equilibrium diagram.

constriction, the bending together of an electric current's flow lines as they pass through a contact point, such as an a-spot.

constriction cooling, the cooling, caused by thermo-electric effects, of a constriction between two co-acting contact surfaces.

constriction resistance, the increase in conductor resistance that is caused by constriction in a connector.

contact, 1. one of two conducting parts that meet and act jointly to make or break an electric circuit. 2. a physical connection between two conducting parts through which electric current flows. *See also* clean contact.

contact area, apparent, the whole area covered by a contact (def. 2), including all load-bearing and non-load-bearing areas.

contact area, load-bearing, one or more areas in an electric contact that carry the mechanical load. The area may consist of three different portions (a) with metallic contact; a-spots (b) covered with a relatively thin oxide film (c) covered with a relatively thick oxide film.

contact area, true, the sum of the areas of metallic contacts at the junction of two conductors; the sum of the a-spot areas.

contact, breathing of, a movement of an electric contact that allows the formation of oxide.

contact potential, the electromotive force that exists at a contact of two substances or phases.

contact pressure, final, the force that one electric contact exerts and continues to exert against its co-contact. The final contact pressure usually is lower than the initial contact pressure.

contact pressure, initial, the force that is exerted between co-contacts when contact is first made.

contact resistance, the resistance, caused by the meeting of two surfaces, that stops or interferes with the flow of electric current. The resistance decreases when increased pressure extends the contact area.

contact surface, the common boundary of two surfaces through which electric current flows.

continuity, in an electric circuit, an unbroken path for current.

continuity test, a test to determine the presence or absence of a broken electric connection.

convenience outlet, *see* receptacle.

cooling, constriction, *see* constriction cooling.

copper conductor, a wholly copper conductor.

copper, deoxidized, *see* deoxidized copper.

copper, electrolytic, *see* electrolytic copper.

copper, high-conductivity, *see* high-conductivity copper.

copper oxide, *see* cupric oxide; cuprous oxide.

copper, oxygen-free, *see* oxygen-free copper.

copper, tough-pitch, *see* tough-pitch copper.

cord, electric, flexible, insulated conductors covered with flexible insulation.

cord set, 1. a slender, flexible electric cord, of varying lengths, that is equipped with fittings to connect electric appliances, etc. to an outlet. 2. a light-duty cord that is suitable for normally dry locations and is not unduly exposed to severe mechanical damage; extension cord. 3. a heavy-duty cord that is suitable for use in damp locations, garages, etc.; extension cord.

corrosion, the gradual wasting away of a metal, which is caused by its chemical or electrochemical reaction with the atmosphere, water, a chemical, etc. *See also* crevice corrosion; deposit attack; electrochemical corrosion; fretting corrosion; galvanic corrosion; intergranular corrosion; wear, corrosion.

corrosion cell, *see* galvanic cell.

corrosion embrittlement, of a metal, severe reduction in ductility as a result of localized corrosion. The damage to the metal is often not visible.

corrosion fatigue, of a metal, the effect of repeated stresses applied in a corrosive environment. Corrosion fatigue results in a service life shorter than that of metal subjected to either the stresses or the corrosive environment.

couple action, *see* galvanic corrosion.

cover plate, a plastic plate on the exterior of an outlet box; face plate.

CPSC, Consumer Product Safety Commission (of the United States).

cracking, the partial fracturing of a body, with the parts remaining united. *See also* season cracking; stress-corrosion cracking.

creep, in a metal, a stretching that occurs under stress over a period of time. *Primary creep* occurs at a diminishing rate. *Secondary creep* occurs at a minimum and almost-constant rate. *Tertiary creep* occurs at an accelerating rate.

creep limit, in a metal, the maximum stress that causes less than a given amount of creep in a specified time.

creep rate, in a metal, the stretching that occurs per unit of time.

creep recovery, in a creep test, the contraction of a metal that occurs after the tensile load is released.

creep strength, 1. the load that stretches a metal a given amount in a given time at constant temperature. 2. the given load for a specified creep rate at constant temperature.

crevice corrosion, in a metal, localized corrosion that is caused by the presence of differing concentrations of salts, oxygen, dissolved gases, etc. and results in the formation of deep cracks or pits.

crimp, compress a sleeve on a conductor in order to make an electric or mechanical connection.

crimp connector, a connector that is tool-compressed to a wire or a combination of wires. *See also* compression lug.

critical humidity, the humidity above which a sharp increase occurs in a given metal's atmospheric-corrosion rate.

cross-sectional area, in a wire, the area measured perpendicular to the wire's axis.

crystal, a solid that has a regular internal molecular structure. *See also* recrystallization.

CSA, Canadian Standards Association.

Cu, copper.

CuO, cupric oxide.

cupric oxide, an oxide of copper, CuO.

cuprous oxide, an oxide of copper, Cu₂O.

Cu₂O, cuprous oxide.

current, a flow of electrons along a wire, etc., usually designated by the symbol *I*. *See also* alternating current; eddy currents; fault current; induced current; inrush current; transient current.

current density, the amount of electric current that flows through a unit area. *See also* local current density.

cutout, fuse, *see* fuse cutout.

damp location, *see* location, damp.

debris, fretting, *see* fretting debris.

deep etching, of a metallic surface, etching to a depth that will reveal any gross features, such as segregation, cracks, porosity, or grain flow.

defect, an imperfection; something that reduces the usefulness of an object, component, etc.

deformation, of a material, a change in the shape, size, etc. that is caused by the application of external or internal stress or load.

Elastic deformation means that the material's original shape, size, etc. is recoverable when the applied stress or load is removed. *Plastic deformation* means that the change in the material's shape, etc. is permanent.

degradation, of a connection, the making or becoming worse; the inability to maintain its original conductivity over a period of time but without necessarily failing.

degradation failure, *see* failure.

density, current, *see* current density.

deoxidize, 1. remove oxygen from molten metals by the addition of suitable deoxidizers. 2. in metal finishing, remove oxide film from metal surfaces by chemical or electrochemical reaction.

deoxidized copper, copper from which oxygen has been removed by the addition of a deoxidizer to the molten metal.

deoxidizer, a substance that combines readily with oxygen, whose addition to molten metal removes oxygen or converts it into an inert form.

deposit attack, corrosion, in the form of small sharp cavities, caused by dust deposits on the surface of a metal.

device, electric-wiring, a branch-circuit component that carries, or allows control of, electric current but does not consume power.

dezincification, in some copper-zinc alloys, a loss of zinc and the formation of a spongy, porous, copper surface.

diamond-pyramid hardness test, a test to determine a material's resistance to indentation. With the use of a 136° diamond-pyramid indenter and variable loads, the hardness of a wide variety of materials can be determined.

dielectric, non-conducting.

differential thermal ratcheting, of a terminal connection, a degradation process which results from the different thermal-expansion rates of the metals during each complete on/off loading cycle and from the tendency towards deformation of the metals in contact due to increased pressure in the joint.

diffusion, 1. in a gas, liquid, or solid, the spreading of constituents, which tends to make uniform the composition of all parts. 2. the directed movement of atoms to new sites within a material. *See also* self-diffusion.

diffusion coefficient, a factor of proportionality representing the quantity of a substance, measured in grams, that diffuses across one square centimetre through a unit-concentration gradient in one second.

dimmer, a device that is used to vary electric current to light fixtures.

discontinuity, in a metal, any interruption (e.g., a crack, lap, seam, inclusion, porosity) in the normal physical structure of a component. A discontinuity may, or may not, affect a component's usefulness.

dislocation, of a crystal, a linear defect in the atomic structure.

dispersed phase, *see* phase, dispersed.

distortion, of an electric wave, an undesired change in the shape.

distribution panelboard, *see* panelboard (def. 1).

DPH, diamond-pyramid hardness. *See also* diamond-pyramid hardness test.

draw, 1. pull a metal ingot into wire. 2. of steel, temper.

drop wire, a cable that is used to bring electric power from a public-utility pole to a building.

dry location, *see* location, ordinary dry.

ductile, easily shaped and moulded.

ductile fracture, a break that absorbs a large amount of energy and involves much permanent deformation.

ductile, notch, *see* notch brittleness.

ductility, the quality of being easily shaped or moulded, measured in a tensile test by the percentage of elongation and reduction in area; formability.

duplex receptacle, a receptacle that contains two contact devices in a single fixture, used for the connection of two plugs. *See also* terminal plate.

earth wire, *see* ground (def. 2).

earthed, *see* ground, effective.

EC, electric conductor.

EC aluminum, an electric-conductor grade of above 99.5% pure aluminum.

eddy currents, electric currents that are developed in a conductor by changes in the surrounding magnetic fields.

elastic constant, *see* modulus of elasticity; Poisson's ratio.

elastic deformation, *see* deformation.

elasticity, in a material, the property that enables it to recover its original size and shape after limited deformation.

elasticity, modulus of, *see* modulus of elasticity.

elastic limit, the maximum stress that a material can tolerate without any permanent deformation remaining after complete removal of the load.

electrical contractor, any person or company licensed to perform any work in connection with any electric installations or any other work to which the Ontario Electrical Safety Code applies.

Electrical Safety Code, a handbook, published by Ontario Hydro, that gives the regulations of the Power Corporation Act of Ontario. The Act deals with the approval, installation, and intended use of electric systems.

electric appliance, *see* appliance, electric.

electric conductivity, *see* conductivity.

electric contact, between conductors, the boundary that allows electric current to flow.

electric cord, *see* cord, electric.

electric phase, *see* phase, electric.

electric resistivity, *see* resistivity.

electric system, *see* alive electric system; service.

electric-wiring device, *see* device, electric-wiring.

electrochemical corrosion, corrosion that is caused by a flow of electric current between the areas of the cathode and the anode on metallic surfaces.

electrochemical potential, voltage that is developed at an electrode in comparison to that at a reference electrode.

electrode, grounding, *see* grounding electrode.

electrodeposition, the plating of a material on an electrode by passing an electric current through an electrolyte; electrolytic deposition.

electrolyte, a solution in which the electric current is conducted by ions.

electrolytic copper, copper that has been refined by electrodeposition. When used alone, this term usually refers to *electrolytic tough-pitch copper*, in which oxygen is the only impurity in significant quantities.

electrolytic deposition, *see* electrodeposition.

electrolytic tough-pitch copper, *see* electrolytic copper.

electromagnetic, of or associated with electric effects of a magnetic field.

electromotive force, voltage; emf.

electromotive series, a list of chemical elements arranged in the order of their standard electrode potentials. For corrosion studies, the galvanic series is more practical and generally is used. The relative position of a metal is not necessarily the same in the two series. *Compare with* galvanic series.

electron charge, the negative charge carried by each electron.

electron compound, in a metal system, intermediate phases that have a common crystal-line structure and the same ratio of valence electrons to atoms.

electron, conduction, *see* conduction electrons.

electroplating, the electrodeposition of a metal or alloy coating on another metal or alloy.

element, *see* alloying element; residual elements.

elongation, in a tensile test, the increase in the gauge length of a material measured after fracture. The increase usually is expressed as a percentage of the original gauge length. *See also* gauge length.

embrittlement, 1. in a metal or alloy, severe loss of ductility. 2. in a metal, a decrease in the normal ductility, which is caused by a chemical attack or physical change. *See also* corrosion embrittlement; hydrogen embrittlement; solder embrittlement.

emf, electromotive force.

enclosed panelboard, *see* panelboard (def. 1).

endurance limit, the maximum repeated stress that, when applied to a material, does not cause a fracture.

endurance test, *see* fatigue test.

energy, activation, *see* activation energy.

entrance panel, service, *see* service-entrance panel.

equilibrium, in a chemical system, a condition with balanced mechanical stresses and without temperature differences or net chemical reactions.

equilibrium diagram, a constitution-equilibrium-phase diagram of an alloy system, that shows the limits of the temperature, pressure, and composition of its phase field in a state of equilibrium; phase diagram. Pressure is usually considered constant.

etching, a process of subjecting a metal's surface to chemical or electrolytic attack. The chemical reaction reveals structural characteristics of the metal. *See also* deep etching; macro-etching.

eutectic alloy, an alloy that has the lowest melting point in the alloy system. The structure consists of a mechanical mixture of the terminal phases.

eutectic reaction, a reversible reaction, at constant temperature, in which a liquid solution forms a solid that is a mechanical mixture of the terminal solid solutions.

eutectoid alloy, an alloy that has the lowest transformation temperature in the alloy system. The structure consists of a mechanical mixture of the solids formed by a eutectic reaction.

eutectoid reaction, a reversible reaction, at constant temperature, in which a solid solu-

tion decomposes to form a solid mechanical mixture. The number of solids in the mixture so formed corresponds to that of the solution's constituents.

evaporation, *see* vaporization.

expansion coefficient, *see* thermal-expansion coefficient.

expansion, thermal, *see* thermal expansion.

exponential function, *see* Arrhenius equation.

extension cord set, *see* cord set (def. 2, 3).

extra-flexible wire, a copper conductor that consists of thirty-seven or more wire strands, used in some baseboard heaters. *See also* Table 44.

face plate, *see* cover plate.

failure, a condition in which a material, device, component, etc. is or becomes unable to perform its specific function. There are three major classes of failure: (a) *catastrophic*, a failure that is sudden and total (b) *degradation* or *gradual*, a failure that occurs over a long period of time (c) *sudden*, a failure that occurs over a very limited time period. *See also* fatigue failure.

failure cause, the circumstance that prevents an item from functioning normally. There are five major classifications of causes of failure: (a) *complete*, a failure (in the item's characteristics) to meet specifications (b) *inherent weakness*, a failure that is due to the presence of flaws (c) *misuse*, a failure that is attributed to overload (d) *secondary*, a failure of one item that is caused directly or indirectly by the failure of a second item (e) *wear-out*, a failure that is caused by a change in dimensions due to use, making the part unserviceable.

failure criteria, an item's specified acceptability limits.

failure mechanism, any process that results in failure.

failure rate, the number of failures per unit time.

fatigue, in a metal, surface or subsurface damage that is caused by repeated stress that is below the yield stress of the metal. *See also* corrosion fatigue.

fatigue failure, of a metal, fracture that is caused by repeated stressing.

fatigue test, a test to determine the number of cycles that causes fracture at a given reversing load; endurance test.

fault current, an electric current that flows (because of an accidental or unintentional connection; e.g., an arc) from one conductor to a ground or another conductor.

Fe, iron.

feed-through receptacle, a receptacle that is wired in such a way that electric current passes through a break-off tab to other receptacles in the circuit.

ferric, 1. of, containing, or having to do with iron. 2. containing a form of iron that has a valence of 3.

ferritic, of iron alloys, characterized by a body-centred cubic crystalline structure.

ferrous, 1. of, containing, or having to do with iron. 2. containing a form of iron that has a valence of 2.

fibre, in wrought metal, the metallic and non-metallic constituents elongated in the direction of stretching (e.g., preferred orientation of crystals produced by wire-drawing). The fibre can be revealed by the etching of a longitudinal section.

Fick's first law of diffusion, the flow of matter is proportional to the concentration gradient.

final contact pressure, *see* contact pressure, final.

finish, the surface roughness of a metal.

fixture, an electric lighting device, equipped with one or more bulb or lamp holders, that is intended for use in a fixed location and for direct connection to a branch-circuit conductor; lighting fixture.

flash, a thin coating of metal applied by a chemical-deposition process to the surface of a terminal.

flexible cable, *see* Table 44.

flexible wire, generally, a copper conductor composed of strands of wire. *See also* Table 44; extra-flexible wire.

flicker, of an electric light, shine with wavering or briefly fluctuating brightness.

flow stress, the stress along one axis of a specimen that is required to begin permanent deformation.

force, mass times acceleration; load.

formability, *see* ductility.

fracture, a breaking; a crack; break. *See also* brittle; ductile fracture.

frequency, ultrasonic, *see* ultrasonic frequency.

fretting, wear that is caused by repeated relative motion between two metallic surfaces in contact.

fretting corrosion, chemical corrosion accelerated by fretting.

fretting debris, the particles generated by wear during fretting corrosion.

fritting, a breakdown of a metal's oxide layer by an application of a voltage. *See also* A-fritting; B-fritting.

full annealing, 1. in a ferrous alloy, heating to form austenite and then cooling slowly through the transformation range 2. in non-ferrous alloys, heating above the recrystallization temperature.

full-hard, *see* temper (def. 2).

fuse, 1. a protective device that is designed to break a circuit when there is an overcurrent; fusible element. 2. melt; melt together. 3. blend; unite. *See also* overfuse.

fuse, cartridge, *see* cartridge fuse.

fuse cutout, a porcelain or bakelite holder or housing for a fuse; cutout.

fuse, plug, *see* plug fuse.

fusible element, *see* fuse.

fusion, a melting or melting together.

galvanic cell, 1. two dissimilar metals in electric contact with each other and with an electrolyte; corrosion cell. The corrosion reaction produces electric energy. 2. a cell in which chemical change produces electric energy. 3. an oxygen-concentration cell.

galvanic corrosion, 1. corrosion that is produced by the electric current in a galvanic cell; couple action. 2. corrosion that results from chemical reaction produced by two similar metals in an electrolyte.

galvanic series, a list of metals and alloys arranged in the order of their electrode potentials in a specific environment. *Compare with* electromotive series.

galvanize, apply a zinc coating to steel to increase its resistance to corrosion.

gauge, 1. a standard measure; scale of standard measures. 2. an instrument to measure thickness, etc. 3. the diameter or thickness of wire, a metal sheet, etc. *See also* American wire gauge.

gauge length, the original length of the portion of a sample over which strain, change of length, etc. are measured.

general-use switch, a type of switch for use in electric general-distribution and branch circuits. *See also* toggle switch.

glide, *see* slip.

glow, a sustained source of heat and light that is given off by a segment of an electric connection.

gradual failure, *see* failure.

grain, a single crystal in a polycrystalline metal or alloy.

grain boundary, the junction between single crystals that differ in orientation.

grain growth, 1. the increase in the size of a crystal or grain that occurs as the temperature is raised. 2. in a crystalline metal or alloy, an increase in the size of grain, usually effected during heating at high temperatures; coarsening. A gradual increase results in uniform grains, while non-uniform grains result from a sudden increase.

grain refiner, a material that is added to molten metal in order to produce a finer grain size in the solidified metal.

grain size, in a metal, a measure based on the average diameter of the grains, which is determined generally on an etched and polished cross section.

ground, 1. any conducting medium, such as a wire, that connects an electric circuit or equipment with the earth or with some suitable substitute for the earth; ground wire. 2. a connection between a ground electrode and earth; earth wire.

ground detector, a instrument or device that indicates an unintentional ground on an electric system.

grounded conductor, *see* neutral conductor.

ground, effective, a ground that protects electric apparatus or equipment from excessive voltages.

grounding electrode, a metal rod buried in the earth, to which a grounding conductor is connected electrically and mechanically.

ground wire, *see* ground (def. 1).

grubscrew, *see* set-screw connector.

half-hard, *see* temper (def. 2).

hard-drawn, of a metal, cold-worked to a high degree of hardness by drawing.

hardening, *see* age hardening; precipitation hardening; quench hardening; solution hardening; strain hardening.

hardness, 1. the resistance of a metal to permanent deformation, usually by indentation. *See also* indentation hardness; Knoop hardness. 2. resistance to scratches, abrasions, or cuts.

hardness test, a test to measure indentation hardness. *See also* Brinell hardness test; diamond-pyramid hardness test; Rockwell hardness test.

hazard, the risk of fire, explosion, or shock caused by energy from electric equipment, devices, etc.

heat capacity, the amount of heat that is required to raise the temperature of one gram of material by one degree Centigrade.

heat conduction, *see* conductivity.

heating, induction, *see* induction heating.

heat, latent, *see* latent heat.

heat sink, 1. a volume of metal, etc. into which heat flows. 2. a part, device, etc. that absorbs heat.

heat, specific, *see* specific heat.

helix, a spiral (e.g., the wire body of a corkscrew).

hertz, a unit of the measurement of frequency, i.e., one cycle per second.

high-conductivity copper, annealed copper that has a minimum electric conductivity of 100% IACS, as determined according to ASTM test methods.

Hooke's law, the amount of stress is directly proportional to the strain where no permanent deformation occurs.

hot spot, in electric components, a region of above-average temperature.

hot working, of a metal, alloy, etc., deformation above the recrystallization temperature.

HUDAC, Housing and Urban Development Association of Canada.

humidity, the amount of moisture in the atmosphere. *See also* critical humidity.

hydrogen embrittlement, of a metal, embrittlement (def. 1) that is due to absorption of hydrogen during a cleaning, pickling, plating, or welding process.

hysteresis, the lagging, or anelastic effect, of a substance's return to its normal shape after removal of the load that caused the original change in shape.

I, current.

IACS, international annealed-copper standard.

identified conductor, *see* neutral conductor.

identified terminals, terminals, to which neutral, or grounded, conductors are to be connected, that are plated with tin, nickel, or some other light-coloured metal for easy identification.

IEE, The Institution of Electrical Engineers.

IEEE, The Institute of Electrical and Electronics Engineers, Inc; formerly AIEE.

impact energy, the amount of energy that is required to fracture a material, usually measured by a Charpy or Izod test; impact value. The type of material and test conditions must be specified.

impact strength, *see* Charpy test; Izod test.

impact value, *see* impact energy.

impedance, the complex property of an electric circuit, or of its components, that opposes the flow of an alternating current. Impedance is composed of resistance and reactance.

incandescence, a visible glow.

In, indium.

in-lb, *see* pound-inch.

indentation hardness, the amount that a material resists indentation; the depth of area of indentation. Various tests are used to measure indentation hardness. In the usual test for hardness, a pointed or rounded object is

pressed into the surface of the test material under a fixed load for a fixed time. *See also* hardness test.

induced current, in a conductor, electric current that is produced by a varying electromagnetic field near the conductor.

induced voltage, in a closed circuit, etc., voltage that is produced by a varying electromagnetic field surrounding the circuit.

inductance, in an electric circuit or conductor, the property that enables a varying current to produce, without direct contact, electromotive force in the circuit, or in a nearby circuit.

induction heating, heating that is due to induced voltage.

initial contact pressure, *see* contact pressure, initial.

inrush current, current that is drawn by electrically powered equipment or devices during the starting period; starting current; surge.

inspection department, the Electrical Inspection Department of Ontario Hydro (unless stated otherwise).

insulate, prevent the passage of electricity, heat, etc. by coating or surrounding with a non-conducting material, air space, etc. Conductors are often insulated by a covering of rubber or other non-conducting material.

insulated wire, *see* wire.

insulating material, 1. any material, object, etc. that has no, or very low, conductivity. 2. in a cable, a part that insulates the conductor from other conductors, conducting parts, or ground.

insulation class ratings, there are many and complex ratings. For information, consult page 287 in *IEEE Standard Dictionary of Electrical and Electronics Terms*.

intercrystalline, 1. between crystals. 2. the grain boundary of a crystal. *See also* transcrystalline.

intergranular corrosion, corrosion that takes place at grain boundaries.

intermediate phase, in a chemical or alloy system, a distinguishable phase composed of similar substances whose range includes no pure constituent of the system. *See also* intermetallic compound.

intermetallic compound, in an alloy system, a separate intermediate phase whose atoms combine in simple integral proportions (e.g., CuZn). The atomic bonding of such a compound can vary from metallic to ionic. *See also* ion (def. 2).

International System of Units, an internationally recognized group of six basic units of measurement: metre, kilogram, second, ampere, Kelvin degree, and candela; *Système international*; SI.

interstitial solid solution, a solid solution in which atoms of the solute occupy spaces, or interstices, within the lattice of the metallic solvent.

intracrystalline, *see* transcrystalline.

inverse segregation, in cast metal, a localized concentration of an excess of constituents with a lower melting point, which takes place in earlier-freezing sections.

ion, 1. an electrically charged atom. 2. an atom, or group of atoms (molecule), that, by gaining or losing one or more electrons, acquires an electric charge. Positive ions, or cations, have lost electrons; negative ions, or anions, have gained electrons.

isotherm, a line that connects all points of constant temperature.

isothermal transformation, a transformation that occurs when a substance is held at a constant temperature for a specific period of time.

Izod test, a specific test to determine the impact strength of a material.

joint, *see* connection.

joint, bolted, *see* connection, bolted.

joint compound, a grease that is used to lubricate and waterproof connections; jointing compound.

jointing compound, *see* joint compound.

joint, soldered, *see* soldered joint.

joule, the SI unit of work and energy. One joule represents the work of a force of one newton acting through a distance of one metre. One joule is equal to one watt for one second.

Joule's law, a law related to the heating effect of an electric current: $\text{power} = I^2R$.

jumper, a short cable used to make connections, usually temporary, between electric circuits and their associated devices.

junction box, *see* outlet box.

junction resistance, in an electric circuit, the difference in resistance between a solid conductor and an equivalent conductor that includes a join.

K, Kelvin degree; °K.

k, Boltzmann's constant.

Kelvin temperature, *see* absolute (Kelvin) temperature.

kip, a load of 1,000 pounds.

Kirkendall migration, a diffusion phenomenon, which occurs occasionally in a contact between a solid metal and an alloy, in which an element of the alloy may move more rapidly into the solid metal than the latter moves into the alloy.

knife-edge connector, a device that effects an electric connection by cutting into a wire with its sharp edges.

knockout, a segment of a side of an outlet box that can be removed easily to permit entry of wires.

Knoop hardness, a specific test to determine indentation micro-hardness of a material.

latent heat, thermal energy that is released or absorbed during a phase change, such as fusion.

lattice, a regular, three-dimensional pattern.

lay, a spiral arrangement made by interlinking, twisting together, etc. an electric cable's individual strands.

lb-in, pound-inch.

lead, a short length of electric wire that is used to make interconnections between the branch-circuit wiring and the equipment terminals. Fixtures and baseboard heaters normally are connected in this manner.

leading tin bronze, *see* bronze (def. 2).

life test, *see* accelerated life test.

lighting branch circuit, a branch circuit that supplies electric energy to lighting outlets only.

lighting fixture, *see* fixture.

lighting outlet, 1. an outlet that makes branch circuits available for connection to lamp holders or other portable fixtures and to fixtures in permanent locations. 2. an outlet for direct connection to a lamp holder or fixture or to a lamp holder's pendent cord.

limiting ambient temperature, the upper or lower limit of the range of temperatures within which a piece of electric equipment can be operated, at its particular rating, in its surroundings.

line conductor, the ungrounded conductor in a branch circuit. *See also* phase conductor.

line terminal, the terminal to which a phase conductor (def. 2) is connected.

liquidus, the temperature range above which an alloy is completely liquid.

live electric system, *see* alive electric system.

live part, an electric conductor that functions at a voltage different from that of the earth.

load, the electric power that is used by devices connected to a source of electric energy; force. *See also* proof load.

load-bearing contact area, *see* contact area, load-bearing.

load centre, an informal term for a combination main service panelboard in a residence.

local current density, density of an electric current at a point or within a small area.

location, damp, 1. a location where a moderate degree of moisture exists, or may exist (e.g., basements). 2. a location where, either normally or periodically, moisture condensation occurs in, on, or near electric equipment.

location, ordinary dry, a location in which electric installations are not exposed to dampness, extreme temperatures, and excessive dust.

location, ordinary wet, a location in which electric installations may be subjected to uncontrolled dripping, splashing, or flowing of liquids.

loop, planar, *see* planar loop.

loss, in an electric device, a dissipation of power, which usually appears as heat.

low-alloy steel, *see* steel, low-alloy.

low-voltage system, an electric system that operates below 750 volts.

lubricant, a substance that reduces friction between two surfaces in contact with each other.

lug, compression, *see* compression lug.

macro-etching, the etching of a surface of a metal in order to study gross structural features without magnification or with no more than ten-diameter magnification.

macrograph, a photograph of the structure revealed by a macro-etching; photomacrograph.

macroscopic, visible to the naked eye or at magnification of not more than ten diameters.

macrostructure, of a metal, the structure as it appears in an etched surface of a polished specimen at no more than ten-diameter magnification.

malfunction, a failure to function properly.

mandrel, a cylindrical rod around which a conductor is formed.

manganese bronze, *see* bronze (def. 2).

martensite, a characteristic constituent of hardened steel. It is produced by suitably heating, then rapidly cooling, the steel body by quenching.

matrix, of a metal, etc., the main phase in which a second phase is enclosed.

maximum demand, the peak demand that occurs during a specific time period.

maximum-design voltage, the highest voltage at which a device is designed to function properly.

mean life, the arithmetical mean of the periods of time that elapse before a group of apparently identical objects ceases to function properly.

mechanical interchangeability, the physical interchangeability of components that is made possible by their common dimensional tolerances, regardless of manufacturer.

mechanical properties, characteristics of a material (e.g., hardness, elongation, fatigue limit, yield strength) that are determined by the application of external forces.

mechanical working, the shaping of a metal by force.

median test life, *see* test life, median.

melting time, the time required for an electric overcurrent to break the current-responsive element in a fuse.

melting voltage, the contact voltage required to melt the contact surfaces.

metal, 1. an elemental chemical substance that is opaque and lustrous, and a good conductor of heat and electricity. 2. an alloy. *See also* basic metal; clad metal; noble metal; precious metal.

metal-clad, of electric conducting parts, enclosed in a metal casing.

metallography, the study of the structure of metals and alloys.

metastable, having a position of apparent equilibrium.

meter, the meter installed by the local electric-utility authority to register the kilowatt-hour energy used on a premises.

Mg, magnesium.

micrograph, a photograph of the structure revealed by etching as it appears at a magnification of between ten and 1,500 diameters; photomicrograph.

microhm, one millionth of an ohm, usually designated by the symbol $\mu\Omega$.

micron, one millionth of a metre (0.001 mm.).

microstructure, in a polished, etched surface of an alloy, grains and phases that are visible under a microscope. *See also* multiphase microstructure.

mil, one thousandth of an inch (0.001 in.). *See also* circular mil.

milliohm, one thousandth of an ohm.

mill scale, a heavy oxide that forms on metals, especially iron and steel, during hot fabrication or heat treatment.

mixture, two or more phases that are combined in a single substance, each retaining its individual characteristics.

Mn, manganese.

modulus of elasticity, the ratio of stress to strain when the material has not undergone permanent deformation; elastic constant; Young's modulus.

molecule, a particle that is composed of two or more atoms joined by strong bonding forces.

multiphase microstructure, an alloy that is composed of two or more phases.

N, newton.

natural ageing, of a metal or alloy, the ageing of a supersaturated solid solution that occurs spontaneously at room temperature. *See also* ageing.

neck, reduce a metal's cross-sectional size in a localized area by stretching; neck down.

neck down, *see* neck.

network, a system of interconnected electric conductors and devices, etc.

neutral conductor, in a multiphase or a single-phase, three-wire circuit, the circuit conductor that is intentionally grounded at the source; grounded conductor; identified conductor. It carries the return current in a single-phase system and the unbalanced current in a multiphase system.

neutral terminal, the identified terminal to which a neutral conductor is connected.

newton, the SI unit of force; N. One newton represents the force necessary to accelerate a mass of one kilogram at the rate of one metre per second per second. $1\text{ N} = 10^5$ dynes.

Ni, nickel.

noble metal, 1. a metal whose potential is highly positive in relation to the hydrogen electrode. 2. a metal that strongly resists chemical reaction, especially the formation of oxides or the dissolving by inorganic acids; precious metal. 3. a non-reactive metal.

noise, 1. in an electric circuit, the presence of unwanted electric energy. 2. in radio, static.

nominal-system voltage, voltage of a standard value (e.g., 220 volts) measured line-to-line.

nonferrous, of an alloy or a metal, containing no iron.

non-metallic sheathed cable, *see* cable, non-metallic sheathed.

notch acuity, sharpness of a notch in a structure.

notch brittleness, in a material, the increase in possibility of a brittle fracture at points of stress concentration, such as a notch, groove, etc. In a notch tensile test, the term *notch brittle* is applied when a material's notch strength is less than its tensile strength; otherwise, the material is said to be *notch ductile*.

notch depth, usually, the distance between the surface of a test specimen and the bottom of the notch. In a cylindrical specimen, the depth is the percentage of the original cross-sectional area removed by machining a circular groove.

notch ductile, *see* notch brittleness.

notch sensitivity, the reduction of a material's fracture strength, which is caused by the presence of a notch, groove, etc.

notch toughness, *see* Charpy test.

nucleation, in a material, the beginning of a new phase change at discrete sites. *See also* nucleus (def. 1).

nucleus, 1. the first structurally stable particle that can initiate recrystallization of an existing phase or the growth of a new phase, and that possesses a junction with the parent matrix. 2. A foreign particle that initiates a similar action. 3. of an atom, the heavy central core containing most of the mass and all of the positive electric charge.

ohm, the SI unit of electric resistance and of impedance, usually designated by the symbol Ω . One ohm is the resistance of a conductor, with a constant current of one ampere, that produces a voltage of one volt between its ends.

Ohm's law, in an electric circuit, the current is inversely proportional to the resistance of the circuit and directly proportional to the voltage in the circuit. The law is accurate for only linear circuits.

open circuit, an electric circuit in which no current flows.

open wiring, a method of installing insulated electric conductors in locations that are not concealed by a building's structure.

operating stress, the stress to which a device, component, etc. is subjected during use.

operational reliability, *see* reliability, operational.

ordinary dry location, *see* location, ordinary dry.

ordinary wet location, *see* location, ordinary wet.

ore, a natural mineral aggregate which may be mined and treated for extraction of one or more of its constituents, usually for profit.

orientation, of a crystal, any arrangement of one set of axes in relation to another reference set of axes. *See also* preferred orientation.

oscillation, repeated motion in the same path.

outlet, in a branch-circuit system, a point at which electric current is available for appliances, fixtures, etc. *See also* lighting outlet; special-purpose outlet.

outlet box, a small box, usually metal, placed at outlets to house the wiring, wiring connections, devices, etc.; backbox; box; junction box.

outlet, lighting, *see* lighting outlet.

outlet, special-purpose, *see* special-purpose outlet.

overageing, of a metal or alloy, ageing that is done for times and at temperatures greater than those necessary to produce maximum strength. Overageing generally decreases strength and increases ductility. *See also* ageing.

overcurrent, a current that is higher than the normal operating value; surge.

overcurrent device, any device that is capable of automatically opening an electric current — by either fusing of metal or electro-mechanical means — under prestatated overload and short-circuit conditions.

overcurrent protection, any device, such as a circuit breaker or fuse, that functions when a preset electric current is exceeded.

overfuse, in an electric circuit, install a fuse with an overcurrent protection that is higher than specified.

overheat, 1. heat a metal or alloy to a temperature high enough to impair its properties. The term *burning* is applied when the material's original properties cannot be restored by further heat treating, mechanical working, or a combination of these two processes. 2. of an electric connection, heat to a temperature, during service or tests, that is higher than average.

overload capacity, the amount of electric current, voltage, or power beyond which a device is damaged permanently. An overload may be acceptable for short periods of time.

overload relay, a relay that operates, or trips, at a higher-than-normal electric load.

oxidation, 1. the combining of oxygen with another chemical element to form an oxide. 2. a chemical reaction characterized by an increase in valence resulting from a loss of electrons. *Contrast with* reduction.

oxygen-concentration cell, a galvanic cell that is caused by different concentrations of oxygen.

oxygen-free copper, copper that contains no cuprous oxide.

P, phosphorus.

panelboard, 1. a complete unit of bus bars, connections, control equipment with or without switches, overcurrent devices, etc. assembled for installation in a cabinet; distribution panelboard. An *enclosed panelboard* is one that is located in a cabinet. 2. a single panel, or a group of panel units assembled as a single panel, that includes bus bars and may or may not include switches and/or automatic overcurrent-protective devices to control light, heat, or power circuits of individual or aggregate capacity; panelbox. This type of panelboard is installed in a cutout box or cabinet in or on a wall and can be reached only from the front.

panelboard, distribution, *see* panelboard (def. 1).

panelboard, enclosed, *see* panelboard (def. 1).

panelbox, *see* panelboard (def. 2).

parameter, a characteristic or feature.

parent, *see* twin.

passivation, of a metal, the changing of a chemically active surface to a much less active condition. *Contrast with* activation.

patina, a green coating that forms on the surface of copper or copper alloys exposed to the air over a long period of time. Patina consists principally of basic sulphate with, occasionally, small quantities of carbonate or chloride.

phase, a physically distinct, mechanically separable portion of matter.

phase, alternating-current, *see* phase, circuit.

phase analysis, analysis of a material that reveals its chemical composition.

phase, boundary, the physical boundary between phases.

phase, circuit, the electric alternating-current circuit supplied by one of the phases in a multiphase (usually three-phase) electric-power supply system.

phase conductor, 1. an electric conductor that supplies a circuit in a multiphase electric-power system. 2. an ungrounded hot, or live, conductor; line conductor.

phase diagram, *see* equilibrium diagram.

phase, dispersed, of a metal, fine particles of matter that occur in matrix phase.

phase, electric, 1. the relationship in time between an alternating current in its cycle and a reference point. 2. of an alternating-current circuit, the ungrounded hot, or live, side.

phase, intermediate, *see* intermediate phase.

phosphatize, coat a metal with phosphate.

photomacrograph, *see* macrograph.

photomicrograph, *see* micrograph.

photon, the smallest quantity of an electromagnetic radiation that has a definite frequency.

physical properties, characteristics (e.g., density, magnetism, electric conductivity, heat conductivity, thermal expansion) that relate to the physics of a material. Physical properties properly do not include mechanical properties.

pigtail connector, a device used to join two or more current-carrying wires. *See also* barrel connector; twist-on connector.

pitting, of a metal, cavities in the surface that are caused by localized corrosion.

plain-carbon steel, *see* steel.

planar loop, a loop, formed in a flat plane, with no spiral or twist shape.

plane, slip, *see* slip plane.

plastic deformation, *see* deformation.

plate, *see* base plate; cover plate; plating; terminal plate.

plating, the process of forming or applying a thin, adherent layer of metal or alloy on an object. *See also* alloy plating; electroplating.

plug, a device, usually attached to one end of a cord, that when inserted into a receptacle, establishes an electric connection between conductors associated with the plug and with the receptacle.

plug fuse, a general-purpose fuse that is used to protect residential branch circuits. The fuse has a screw-type metal base and a glass top through which the fuse element can be viewed to determine the condition of the fuse. The fuse is available in 15-, 20-, 25-, and 30-ampere ratings.

Poisson's ratio, the ratio of the transverse strain to the longitudinal strain when the part is stretched longitudinally.

polish, smooth a metallic surface with abrasives or by electrolytic action.

polycrystalline, of a solid, composed of many crystals.

polygonization, the tendency of crystals to align themselves vertically into grain boundaries between polygonal structures.

pore, 1. a small, empty cavity in the interior of a metal or at the junction of partially welded metals; void. 2. a minute cavity that occurs, sometimes intentionally, in an object made of compressed metallic (sometimes including non-metallic) powders; void. 3. a very small hole in an electroplated coating.

porosity, the existence of pores or small cavities within a metal or at the surface of a partial weld.

pound-inch, a unit of bending moment or tension; lb-in; in-lb.

Power Corporation Act, an Act of the Province of Ontario that deals with the approval, installation, and intended use of electric systems. Regulations of the Act are stated in the Electrical Safety Code.

precious metal, a relatively scarce and valuable metal, such as gold, silver, and platinum-group metals. *See also* noble metal (def. 2).

precipitation hardening, of an alloy, the hardening caused by the precipitation of one of its constituents from a supersaturated solid solution. *See also* age hardening; ageing.

precipitation heat treatment, of a metal, a process of solution treatment and artificial ageing that causes precipitation of a constituent from a supersaturated solid solution.

precision, the closeness with which each of a number of similar measurements approaches the arithmetical mean. *See also* accuracy.

predicted reliability, *see* reliability, predicted.

preferred orientation, in a polycrystalline metal, a condition in which the crystals are arranged in a pattern.

pressure welding, a process of welding in which pressure is used to form metal-to-metal bonds.

pressure-wire connector, a device that, by means of mechanical pressure and without the use of solder, connects two or more conductors or one or more conductors and a terminal.

primary creep, *see* creep.

private residence, a separate dwelling, or a separate apartment in a multiple dwelling, that is occupied by members of a single family unit.

process tolerance, the dimensional variations of a particular part that are permitted in a specific process.

proof load, a predetermined load to which a test specimen is subjected before the item is accepted for use.

proof stress, 1. in a material, stress that will cause a specified small amount of permanent deformation. 2. a specified stress that is applied to a component, structure, etc. to show that it can withstand service loads.

proof test, a test to indicate an item's satisfactory condition in one or more aspects.

proportional limit, the maximum stress to which a material can be subjected and at which the strain remains directly proportional to the stress.

protection, sacrificial, *see* sacrificial protection.

protective coating, *see* clad metal.

protective relay, a type of relay that is used to detect and control abnormal or dangerous conditions in an electric-power system.

psi, pounds per square inch.

push-in connection, *see* backwiring.

push-in terminal, a receptacle with spring-loaded contacts; quick-connector feature. To complete the electric circuit, the stripped conductor needs only to be pushed into the contacts.

PVC, polyvinylchloride. *See also* insulation class ratings.

quarter-hard, *see* temper (def. 2).

quench, cool rapidly.

quench ageing, the process of ageing of rapidly cooled solid solutions. *See also* ageing.

quench annealing, the process of annealing a ferrous alloy by solution heat treatment.

quench hardening, the process of hardening certain ferrous alloys by solution heat treatment and rapid cooling to form martensite.

quenching, the process of cooling rapidly. There are many specific methods of quenching.

quick-connect feature, *see* push-in connector.

quick wiring, *see* backwiring.

ratcheting, *see* differential thermal ratcheting.

rate of strain hardening, the rate of change of stress in relation to strain when the metal is permanently deformed.

real area of contact, *see* contact area, true.

receptacle, a contact device placed at an outlet, to which a cord set is connected in order to supply electric current to portable appliances or fixtures; convenience outlet; socket. *See also* duplex receptacle; feed-through receptacle; single receptacle; split receptacle; split-switched receptacle; three-conductor receptacle; unmodified receptacle.

receptacle circuit, a branch circuit to which only receptacles are connected.

recovery, a process in which the effects of strain hardening of metals are reduced or removed without a significant change of the grain structure or mechanical properties. *See also* creep recovery.

recrystallization, 1. a change from one crystal structure to another, which takes place, for example, on heating or cooling a substance through a transformation temperature. 2. the formation, usually through heating, of a strain-free grain structure different from that in cold-worked metal.

recrystallization annealing, the annealing of cold-worked metal to produce, without a phase change, a new grain structure.

recrystallization temperature, 1. the temperature at which cold-worked metal forms, within a specified period of heating, a new, strain-free grain structure. 2. the temperature, usually from one-third to one-

half the metal's melting point, above which new grains form spontaneously in cold-worked metal.

rectification, the process by which electric energy is changed from an alternating-current to a direct-current circuit.

rectifier, a device that permits an electric current to flow in only one direction.

reduction, the removal of oxygen from an oxide to form a metal or an oxide having a lower valence. *Contrast with* oxidation.

reduction of area, 1. in a tensile test, usually the difference between the original cross-sectional area of a metallic specimen and the minimum cross-sectional area at the point of fracture. The difference is expressed as a percentage of the original area. 2. in a metal, the measure of ductility at a fracture.

reel, a spool or similar object around which wire or strip material is wound.

refiner, grain, *see* grain refiner.

relaxation, of a metal, a decrease in some mechanical property, which takes place over a period of time and occurs more rapidly at elevated temperatures. *See also* stress relaxation.

relay, *see* overload relay; protective relay.

reliability, 1. the probability that a device, etc. will function adequately for the period of time intended for its particular operating conditions. 2. the probability that a device, etc. will not fail to function adequately under specific conditions of time and amount of usage.

reliability, operational, an estimate, based on actual-usage (service) data, of an item's reliability; service reliability.

reliability, predicted, an estimate of an item's reliability based on its overall design and the reliability of each of its parts under actual-usage (service) conditions.

reliability test, *see* accelerated reliability test.

residence, *see* private residence.

residual elements, substances that are present in small quantities of a metal but which are not added on purpose.

residual stress, 1. stress that exists in a material and is not caused by external forces or thermal variations. 2. stress that is caused by variations in temperatures of different portions of a volume of a material.

residual torque, *see* torque (c).

resistance, 1. the property of a conductor that opposes the flow of current. Resistance is defined in Ohm's law by $V = IR$. 2. that property of an electric circuit, or of its components, that opposes an alternating current's flow; impedance (real). *See also* constriction resistance; contact resistance; junction resistance.

resistivity, the resistance to the transfer of electric or thermal energy along a potential gradient; the reciprocal of conductivity.

retrofit, modify an existing electric installation by replacing some of the equipment or devices with the latest products which incorporate some desirable characteristic.

RMS, root mean square.

Rockwell hardness test, a test to determine the hardness of a material by measuring the depth of penetration of a hardened-steel ball or a diamond cone under conditions of fixed load and time.

root mean square, the square root of the sum of the squares; RMS.

rope-lay conductor, a cable composed of helically laid groups of wires layered around a core.

roughness, a surface that is uneven and irregular. All real surfaces are rough to some extent. *Contrast with* smoothness.

runaway, an uncontrolled action or activity. *See also* thermal runaway.

rust, a coating of hydrated iron oxides, caused by corrosion of ferrous alloys.

S, sulphur.

sacrificial protection, in an electrolyte, protection of a metal against corrosion by joining the metal to a metal higher in the galvanic series.

scale, mill, *see* mill scale.

screw, a type of fastener that is used to hold wires or clips securely in electric components, etc.; binding head; clamping screw. Screws normally are manufactured of steel or brass and may be plated or unplated. The screw's binding head may be made with or without a groove on the underside. The groove allows threading closer to the head and holds the electric conductor more securely. *See also* torque.

season cracking, a cracking, usually in brass, that results from the combined action of corrosion and internal stress.

secondary conductor, *see* service.

secondary creep, *see* creep.

segregation, of an alloy, an uneven distribution of its elements, impurities, or phases. *See also* inverse segregation.

self-diffusion, of an atom, the spontaneous movement to a new position in a crystal of its own kind.

semiconductor, a material whose conductivity is intermediate between that of a conductor (metal) and an insulator. The resistivity of a semiconductor decreases as the temperature increases.

service, an electric system that consists of the conductors and equipment necessary to deliver electric energy from the street main, or *secondary conductor*, or other distribution feeder or a transformer to the wiring system of a premises. Service for overhead circuits includes the conductors from the last line pole to the service fuse or switch. A *service drop* is the part of the overhead circuit between the pole and the building served.

service box, a metal box or cabinet that contains either service fuses and a service switch or a circuit breaker. The box must be constructed so that it can be locked or sealed, and either the switch or circuit breaker may be manually operable when the box is closed. *See also* service-entrance panel.

service conditions, *see* ambient conditions; unusual service conditions.

service, consumer's, all the parts of a consumer's installation from the service box, or its equivalent, to and including the point at which the connection is made by the electric-utility company.

service drop, *see* service.

service-entrance panel, usually, a unit combining the main service switch and the panelboard (def. 2).

service reliability, *see* reliability, operational.

service supply, any one set of conductors from an electric-utility company's mains to a consumer's service.

set-screw connector, an inset screw that can be tightened on wires to make an electric connection; grubscrew; tunnel-type connector.

shear plane, *see* slip plane.

shear stress, in a metal, the stress that acts over the slip plane.

sheathed cable, *see* cable, non-metallic sheathed.

short circuit, an accidental or unintentional connection of relatively low resistance between two points of different potential in an electric circuit.

SI, *see* International System of Units.

Si, silicon.

silicon bronze, *see* bronze (def. 3).

silver-surfaced, a metal that has a silver coating to enhance long-term performance of connectors.

single receptacle, a receptacle with one contact, to which only one plug can be attached.

sintering, a heating operation that increases bonding at a contact interface. Bonding takes place when two contacting bodies are pressed together; cohesion is improved after heating.

sliding, *see* tangential motion.

slip, of a metal, a permanent deformation which is caused by the sliding of one plane of atoms over another plane; glide.

slip band, in a metallic surface, a region where parallel slip lines are so close together that, under an optical microscope, they appear to form one line.

slip direction, in a crystal, the direction in which the slip planes are displaced.

slip line, a trace or marking of a crystal's slip plane that is visible on a metal's surface. The trace usually can be seen only on a surface that has been polished before deformation.

slip plane, in a crystal, the structural plane on which a slip occurs; shear plane.

small cable, *see* cable.

smoothness, a surface that is relatively even and regular and can be traversed easily. No real surface is perfectly smooth. *Contrast with* roughness. *See also* surface finish (def. 2).

Sn, tin.

socket, *see* receptacle.

softening temperature, the temperature at which a metal recrystallizes.

softening voltage, the voltage that is required to recrystallize a metallic contact interface.

solder, 1. a metal or alloy with a relatively low melting point (usually below 425°C.) that is used to join metal. Soft solders usually are lead-tin alloys. 2. join a metal or alloy with solder.

solder embrittlement, in a metal, a reduction in ductility which is caused by penetration of solder along the grain boundaries.

soldered joint, a joint of like or unlike metals made, without fusion of the base metals, by the application of molten solder.

solid-phase reaction, in a solid, a reaction between phases.

solid-phase welding, any welding process that uses pressure, or heat and pressure, to complete a weld without fusion.

solid solution, a single phase composed of two or more metals that are soluble in each other. *See also* interstitial solid solution.

solidus, the temperature range below which an alloy is completely solid.

solute, in a liquid or solid solution, a component that dissolves in a solvent. The solute is the lesser component of a solution.

solution hardening, a process by which a solute hardens and strengthens the matrix material by distorting a solvent's crystal lattice.

solution heat treatment, of an alloy, a process of heating to a suitable temperature, holding at that temperature until one or more constituents enter solid solution, and cooling quickly enough to keep the constituent in solution. The cooled alloy is in an unstable supersaturated state and later may quench-age.

solvent, in a liquid or solid solution, a component that dissolves another component (solute). The solvent is the greater component of a solution.

spark, a very brief flash of light that accompanies a sudden and large increase of electric current discharged under electric stress.

special branch circuit, *see* branch circuit, special.

special-purpose outlet, a point of connection to the circuit for a particular appliance. Such outlets, equipped with suitable wiring devices, may be installed in or on the walls. They also may be enclosed in, and be an integral part of, a piece of equipment.

specific heat, the amount of heat that is required to raise the temperature of one unit of mass by one degree.

splice, a device that connects two lengths of electric conductor or cable in a series.

split receptacle, 1. a duplex receptacle with terminals adapted for connection to a grounded three-wire 120/240-volt or 120/208-volt power source. 2. a receptacle from which the break-off tab has been removed.

split-receptacle circuit, a branch circuit that supplies a split receptacle.

split-switched receptacle, a split receptacle that is supplied from a 115-volt electric circuit, on one side directly and on the other through a switch.

stabilizing treatment, any process that minimizes or prevents a change of structure or dimensions of a component.

stainless steel, *see* steel, stainless.

standard deviation, a measure of statistical variation in data.

starting current, *see* inrush current.

steel, an iron-base alloy, that also contains carbon, manganese, silicon, sulphur, and phosphorus. *See also* alloy steel; carbon steel.

steel, low-alloy, steel whose maximum alloy content is five per cent per weight.

steel, plain-carbon, *see* steel.

steel, stainless, steel to which chromium has been added to give corrosion resistance. Nickel may be added.

step-stress test, a test to determine the reliability of a material. A number of stress levels, increased at each level and of equal duration, are applied sequentially to the test specimen.

strain, deformation of a material that results from the application of stress.

strain ageing, the process of ageing that occurs after cold working. *See also* ageing.

strain hardening, an increase in a material's hardness and strength which is caused by permanent deformation at temperatures lower than the range at which recrystallization occurs; work hardening. *See also* rate of strain hardening.

strand, a wire, or a group of wires, in a stranded conductor. *See also* Table 44.

strength, the ability of a material to bear a mechanical load. *See also* creep strength; tensile strength; yield strength.

strength breaking, stress that is required to fracture a material.

stress, the load divided by the cross-sectional area of a body. *See also* flow stress; operating stress; proof stress; residual stress; shear stress.

stress-concentration factor, the factor by which the nominal stress is increased locally in the region of a notch.

stress-corrosion cracking, of a metal, etc., failure by cracking that is caused by the combined action of corrosion and either externally applied or residual internal stress. Cracking may be either along the grain boundary or across the grains, depending upon the particular metal and corrosive.

stress raiser, in a metal, any change in shape or any structural defect that causes a localized increase in stress.

stress relaxation, in a metal, the reduction of stress that occurs with time and that may be accelerated by an increase in temperature.

stress relief, a process of heating a material to a suitable temperature, holding at that temperature long enough to reduce residual stresses, and cooling sufficiently slowly to minimize development of new residual stresses.

sub-boundary, *see* subgrain.

subgrain, of a crystal or grain, a part whose orientation differs slightly from that of neighbouring parts of the same crystal or grain. Neighbouring subgrains usually are separated by low-angle boundaries; sub-boundary.

sublimation, *see* vaporization.

sudden failure, *see* failure.

supercool, 1. of a liquid, cool below its normal freezing point. 2. of a solid, cool below its normal transformation temperature.

supertemperature, the temperature of the a-spots in the contact interface. Because the contact area is reduced, the current density in the contact spots or regions is higher than in the contact bodies, which results in a higher temperature.

surface, the external boundary of a solid or liquid. *See also* contact surface.

surface finish, of a metal, 1. the condition of the surface that results from a final treatment. 2. measured characteristics of the profile of a surface; roughness; smoothness.

surge, *see* inrush current; overcurrent.

switch, 1. a device, generally hand-operated, that is used to turn electric current off or on by opening or closing a connection in a circuit. A switch may be a component of an electric appliance or lighting fixture or it may be located on a wall, etc. 2. any device that makes, breaks, or changes connections in any electric circuit. *See also* general-use switch; toggle switch.

system, ground, *see* ground.

Système international, *see* International System of Units.

tab, break-off, *see* break-off tab.

tangential motion, at a contact, a movement that is perpendicular to the direction of the applied force; sideways, or perpendicular, motion that occurs along the contact interface when a force that is normal to the contact interface is applied; sliding.

tarnish, a discoloured film on the surface of a metal (e.g., silver) that is caused by corrosion.

temper, 1. reheat hardened cast iron, hardened steel, or, sometimes, normalized steel to some degree below the eutectoid temperature. The treatment decreases the metal's hardness and increases the toughness. 2. mechanically or thermally treat nonferrous alloys or steels that cannot be hardened by heat treatment, to increase hardness and strength. Such materials can be cold-worked to a *full-hard* temper, or to such intermediate tempers as *half-hard* or *quarter-hard*.

temperature, abnormal, in functioning electric-wiring devices, an increase in temperature sufficient to cause charring of combustible materials, short circuits, or harmful deterioration of conductor insulation. An abnormal temperature increase may be considered as a sign of a fire hazard.

temperature, ambient, *see* ambient temperature.

temperature, recrystallization, *see* recrystallization temperature.

temperature, softening, *see* softening temperature.

tensile, 1. having to do with tension. 2. capable of being stretched, drawn out, etc.

tensile strength, the maximum load that a metal is capable of bearing; ultimate strength.

terminal, a connecting device that is attached to a conductor, a conducting part of a circuit, etc. *See also* identified terminals; line terminal; neutral terminal; push-in terminal.

terminal plate, in a duplex receptacle, a metal plate that holds the binding-head screw and that is clamped mechanically against the current-carrying conductor or ground wire; base plate. The thickness of the plate shall be twice the pitch of the screw's thread but a minimum of 0.030 inch and shall contain at least two full threads.

terminal thread, *see* terminal plate.

termination, an electric conductor that is joined or connected to a terminal. *See also* connection.

tertiary creep, *see* creep.

test life, median, a given number of test heat cycles of which half the test specimens fail or may be expected to fail.

thermal agitation, a movement of atoms that is induced by heat.

thermal conductivity, the ability of a substance to conduct heat.

thermal expansion, an increase in length that is caused by a rise in temperature.

thermal-expansion coefficient, the symbol representing the amount of thermal expansion; expansion coefficient.

$$\alpha = \frac{\text{change in dimension}}{\text{change in temperature}}$$

thermal ratcheting, *see* differential thermal ratcheting.

thermal runaway, of a joint, a rapid rise in temperature.

thermocouple, a device for measuring temperature, which consists of two unlike metals joined at two points of differing temperatures. The electromotive force produced between the two junctions is approximately proportional to the difference in temperatures at the two points.

thermostat, a device that is used to regulate the temperature. Usually the device is set at the desired temperature, and maintains that temperature by automatically opening and closing an electric circuit.

thread, terminal, *see* terminal plate.

three-conductor receptacle, a split receptacle, one side of which is supplied from a 115-volt electric circuit, and the other from a second 115-volt circuit. The two circuits have a common conductor and form a three-conductor 115/230-volt circuit.

toggle switch, a type of switch, the most commonly used style used for residential-lighting circuit control, which normally is located in a wall outlet box; wall switch. The switch has a protruding lever which, when operated manually, controls a toggle mechanism for opening and closing the electric-contact assembly of the switch.

tolerance, process, *see* process tolerance.

torque, a movement of a force, or system of forces, that causes rotation or torsion. In a binding-head screw connection (a) the *initial torque* is the torque that exists when the connection is made (b) the *installation torque* is the torque that an installer applies to make the connection (c) the *residual torque* is the torsional force that is required to loosen a terminal screw after the connection has been in operation for a period of time or has been subjected to tests.

torque, initial, *see* torque (a).

torque, installation, *see* torque (b).

torque, residual, *see* torque (c).

torr, a unit of pressure, which is used in measuring partial vacuum. One torr is equal to 1/760 of a standard atmosphere.

torsion, 1. the process or act of twisting a material, etc. by an external torque. 2. the state of being twisted.

toughness, of a metal, the ability to absorb energy and to deform permanently without fracturing.

tough-pitch copper, a kind of copper that is produced by refining it in a reverberatory furnace. Such copper contains from 0.02% to 0.05% oxygen by weight and is characterized by a high degree of toughness.

transcrystalline, through a crystal; intracrystalline. *See also* intercrystalline.

transient current, in rotating machinery, current that exists under unsteady conditions.

transverse, in a metal, a plane or direction that is perpendicular to the direction of elongation.

true contact area, *see* contact area, true.

tunnel effect, *see* tunnelling.

tunnelling, the ability of conduction electrons to penetrate a contact film on the surface of a metal, etc. Normally, the film acts as an insulator. *Tunnel effect* is the process of penetration of a contact film.

tunnel-type connector, *see* barrel connector; set-screw connector.

twin, in a crystal, a portion that has a definite crystallographic relation with another portion (the parent). The twin's orientation is either (a) a mirror image of the parent's orientation about a twinning plane, or (b) derived by rotating the twin about a twinning axis.

twin band, on the polished, etched surface of a metal, the section through twin and parent portions of a crystal.

twin crystal, *see* twin.

twinning axis, in a crystal, the axis of rotation for twin formation.

twinning plane, in a crystal, the interface between the twin and the parent.

twist-on connector, a type of pigtail connector, that has a spiral metallic spring; wire-nut connector.

UL, Underwriters' Laboratories, Inc.

ultimate strength, *see* strength, tensile.

ultrasonic cleaning, of a metal, a process of cleaning by immersion in a liquid that is stirred by ultrasonic waves.

ultrasonic frequency, of elastic waves, a frequency that is above the highest audible frequency, usually higher than 15 kilocycles per second.

uniaxial, 1. of or having one axis. 2. having to do with a state of stress in which two of the three principal stresses are absent.

unmodified receptacle, a receptacle that has two contact devices, unless specified otherwise, and is wired directly to a 115-volt electric circuit.

unusual service conditions, any condition in the surroundings of electric devices, appliances, etc. that affects their design, construction, or operational requirements. Such conditions may include (a) moisture (b) abrasives (c) corrosives (d) explosive atmosphere (e) inadequate ventilation (f) uncommon conditions in connection with the electric supply (g) mechanical loading (h) location of the device, etc.

useful life, the period of time during which an electric device, etc. functions without any appreciable deterioration in its performance. *See also* reliability.

utility company, a company that generates, transmits, and sells electric energy.

V, volt.

vacancy, in a lattice, a temporarily empty site of an atom. Diffusion in most materials can be regarded as a directed movement of vacancies.

valence, of an atom, the relative quality to combine with other atoms.

vaporization, of a coating of a material, the state or process of transformation from a solid or liquid into a gaseous substance; sublimation; evaporation.

vibration, of a component, a small oscillatory mechanical motion.

Vickers hardness test, *see* diamond-pyramid hardness test.

void, *see* pore (def. 1, 2).

volt, the SI unit of electromotive force, or voltage; V. One volt causes a constant electric current of one ampere to flow between two points of a conducting wire when one watt of power is lost between the points.

voltage, electromotive force; emf. *See also* induced voltage; low-voltage system; maximum-design voltage; melting voltage; nominal-system voltage; softening voltage; volt.

voltage drop, the difference between the voltage potentials at various points of a circuit measured with respect to a reference point.

W or w, watt.

wall switch, *see* toggle switch.

watt, the SI unit of power; W or w. One watt is the amount of power required to do work at the rate of one joule per second.

waveform, the geometric shape of voltage and electric current as functions of time.

waveform distortion, any deviation from the characteristic waveform.

wear, any damage on the surface of a material, item, etc. that is caused by mechanical action.

wear corrosion, corrosion that is associated with wear.

welding, *see* cold welding; pressure welding; solid-phase welding.

wet location, *see* location, ordinary wet.

wicking, in a cable, the flowing of solder along the strands and beneath the insulation.

Wiedemann-Franz ratio, the quotient of the thermal conductivity divided by the electric conductivity.

wire, a slender, solid, threadlike rod of drawn metal, in varying lengths, that is used to transmit electricity. Wires may be covered with insulation; in such cases, they correctly are termed *insulated wires*. When *wire* appears by itself in a context that indicates clearly that it is insulated, the wire is considered to be an insulated wire. *See also* Table 44; drop wire; extra-flexible wire; flexible wire; lead.

wire bar, a cast object, especially of tough-pitch copper, whose cross section is roughly square in shape. Wire bars are hot-rolled into rods that are then drawn into wire.

wire connector, a device for connecting electric circuits by joining (a) two or more conductors, or (b) one or more conductors to a terminal point.

wire-disturbance test, a special laboratory test, part of the CO/ALR specification.

wire drawing, the process of reducing a cross section of wire to the desired diameter by pulling the wire through a die.

wire, extra-flexible, *see* extra-flexible wire.

wire, flexible, *see* flexible wire.

wire gauge, *see* American wire gauge.

wire-nut connector, *see* twist-on connector.

wiring, *see* backwiring; open wiring.

wiring devices, *see* dimmer; receptacle; switch.

work hardening, *see* strain hardening.
working, cold, *see* cold working.
working, mechanical, *see* mechanical working.

yield point, in certain metals, the point at which an increase in deformation occurs without an increase in stress. Two yield points, upper and lower, exist if stress decreases after yielding.

yield strength, the stress at which a material shows a given deviation (0.2% for many metals, including aluminum) of stress in relation to strain; yield stress.
yield stress, *see* yield strength.
Young’s modulus, *see* modulus of elasticity.

Zn, zinc.

Table 44
STRANDINGS FOR BUILDING WIRE AND CABLE

Nominal Wire Size		Standard			Flexible			Extra-Flexible		
		Number of Wires	Diam. of Each Wire Inches	Diam. of Stranded Conductor Inches	Number of Wires	Diam. of Each Wire Inches	Diam. of Stranded Conductor Inches	Number of Wires	Diam. of Each Wire Inches	Diam. of Stranded Conductor Inches
AWG	Circular Mil Area									
14	4110	7	0.0242	0.0726	19	0.0147	0.0735	37	0.0105	0.0735
12	6530	7	0.0305	0.0915	19	0.0185	0.0925	37	0.0133	0.0931
10	10380	7	0.0385	0.116	19	0.0234	0.117	37	0.0167	0.117

NOTES:
1. These wire sizes are customarily supplied with solid conductors.
2. Any more flexible stranding is acceptable, provided the weight of copper is correct.
Commission’s note: The data in this table are extracted from Table D7 in the Canadian Electrical Code, Part 1.

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